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THE DEVELOPMENT AND CLINICAL VALIDATION OF A PSYCHOLINGUISTIC TEST FOR APHASIA

by

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled THE DEVELOPMENT AND CLINICAL VALIDATION OF A PSYCHOLINGUISTIC TEST FOR APHASIA submitted by MAYADEVI GANTE in partial fulfilment of the requirements for the degree of DOCTOR OF PHILOSOPHY in PSYCHOLINGUISTICS.

This thesis is

dedicated to my parents,

Parvathy and Nanjunda Rao

ABSTRACT

The present study relates to the development of a test for aphasia based on the psycholinguistic model of language proposed by Baker (1976) and Prideaux (1979). This model, called the Information Structure model, accounts for the description of linguistic forms at the surface level, along with the functions these forms signal. The model suggests that there are four categories of information that are encoded in every sentence. These categories range from simple denotation (nouns, verbs, adjectives, prepositions, negation, etc.) through relational information (modification, grammatical roles) and sentential information (questions, statements) to subtle discourse-structuring contextual notions which may direct the choice of alternative syntactic patterns (such as active vs. passive sentences). The model claims that it is the choice of information from each of these categories which directs the form (structure) of the utterance.

The test consists of tasks eliciting performance on the expression and comprehension of language forms associated with the information categories. The experimental aspect deals with the clinical validation of the psycholinguistic test and the consequent analysis of aphasic responses. The subject population consists of normals (for collecting the normative range of responses and for ranking the test tasks

to establish difficulty level), brain-damaged nonaphasics, and brain-damaged aphasics. The testing procedure involved the elicitation of verbal and nonverbal response to the various tasks of comprehension and expression on an individual basis.

The results indicate that the performance of aphasics is clearly distinct from normals and nonaphasics, thus establishing the predictive validity of the test. The test results clearly show defective language on all information levels systematically. The elicitation of gestural responses in the absence of verbal responses also indicates the amount of retention of information structures. The findings of such an analysis provide the basis for rehabilitation therapy. An example of such an approach would be to begin the patients's retraining with material from the information category best retained.

The study acts as a point of intersection between the fields of linguistics and aphasiology, in that it provides an examination of the construct validity of the psycholinguistic Information Structure model.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. INTRODUCTION

1.1 Linguistic rationale for the study

> The field of psycholinguistics has been defined as the investigation of the relationships among producers of messages, messages, and the receivers of messages. Thus, the area, broadly defined, is concerned with both the decoding and encoding aspects of message production and reception as well as the analysis of the messages themselves. (Osgood & Miron, 1963, p. 150)

The field of experimental psycholinguistics is concerned with the investigation of messages, and the encoding and decoding processes in language by the use of observable language data. Such data may come from studies of language acquisition, from normal adult language processes or from studies of the breakdown of the process in language pathology.

The study of language is the study of a human activity. It is the study of 'what people acquire when they acquire a language, of how they acquire it, and of how they use it when producing and understanding messages (Foss & Hakes, 1978).' The specific aim of such a study should be a

description of the coding structures of a language and their semantic functions, against which questions about language as a psychological process can be formulated and tested.

The existence of the relationship between brain and language has been long recognized (Lenneberg, 1967), and accordingly it seems obvious that data produced by the disrupted language system of aphasic patients can contribute to the study of normal language. The important aim here is to discover what can be learned from a study of the brain-language relationship about the psychological processes involved in language use. Linguistic studies of aphasia help to describe features of language performance, because the primary problem faced by the aphasic patient is verbal communication. It can be hypothesized that errors seen in aphasic language reflect the aspects of linguistic structures and their processes.

Linguistic insights into aphasia may contribute to knowledge of the relationship between messages and their processing and act as a testing ground for linguistic theories and models. Psycholinguistics can offer explanation for the linguistic behavior of aphasic patients and suggest techniques for rehabilitation. Here the assumption is that psycholinguistics deals with language use, and the psychological processes involved in using linguistic knowledge. The field of aphasiology offers scope for the study of disruptions in the use of linguistic knowledge and the psycholinguistic processes such as comprehension and

expression. Against this rationale, an intersection between the two fields, viz., psycholinguistics and aphasiology, is considered to be the main focus of this study.

The range of approaches to the study of aphasia has been varied, as the problem of aphasia poses issues that are of interest to linguists, neurologists, psychologists, psycholinguists and speech pathologists. The neurological approach to the study of aphasia, for example, Luria (1970), aims at the description of the relationship between the site of lesion and the resulting behavioral change. The psycholinguistic approach, for example, Osgood (1963, 1980) emphasizes the linguistic disruptions seen as a result of brain damage. But for a speech pathologist interested in the language rehabilitation of aphasic patients, a linguistic approach to the study of language performance is considered very important. Such an approach connecting the fields of aphasiology and linguistics is emphasized by Pincas (1965), Green (1970), Vantreen (1975) and Lesser (1978). However, in the following paper only the studies dealing primarily with the language disturbances in aphasia related to standardized testing are discussed. Consequently, the study emphasizes the psycholinguistic approach relating to the 'disruption of language use' seen with aphasic patients.

1.2 A general overview of the aphasia syndromes

> Aphasia can be defined as a multimodality language disturbance caused by brain injury. It is a linguistic deficit that causes the individual to have difficulty in the comprehension or formulation of language symbols. Aphasia is not generalized intellectual impairment, apraxia of speech, confused language, or dysarthria, although components of any combination of these disorders may accompany aphasic disturbance. (Halpern, 1978, p. 380)

Consequent to brain damage, the aphasic condition is seen as an impairment of the acquired capacity to comprehend and use verbal symbols for interpersonal communication. From a linguistic point of view, aphasia constitutes an impairment in the individual's previously established ability to deal with verbal symbols. Because all language requires the use of symbols, linguistic functions are disturbed. Aphasia therefore is a disturbance in symbolic formulation and expression (Head, 1926). The aphasic patient experiences difficulty to a greater or lesser degree in comprehending and in expressing meaning through the use of verbal symbols. In its broadest sense, aphasic disturbance may be manifest in the individual's ability to deal with any and all types of symbols. These may include nonlinguistic as well as linguistic symbols, for example, gestural and graphic. As a general finding, the degree and specific forms of the difficulty vary with individual patient depending on the site and extent of brain damage.

Disturbances in language function constitute the major but not the only part of the symptomatology of aphasia.

Other symptoms include modifications in attitude or personality, as well as overt behavioral changes in the intellectual and emotional spheres. As such, aphasic disturbances may be divided into three major categories:

1. Communicative disturbances (symbolic and related disturbance).
2. Psychological disturbances (intellectual change and personality modification).
3. Physiological disturbances (hemiplegia, praxias, etc.).

In a given individual, these changes are interrelated, and the linguist concentrating on the first cannot afford to ignore the possible effects of the second and third upon his observations.

Aphasic linguistic disturbances have been classified in many ways and by specific form of defect, for example, Head, 1926; Eisenson, 1954, Critchley, 1970. Chiefly, two major types of linguistic disturbance are seen in aphasia. Receptive aphasia refers to disturbances in the comprehension of audible speech which normally is received and evaluated through hearing, but may also include a reading deficit (alexia). Here the individual may have greater difficulty in understanding abstract words as opposed to concrete; longer words than short; infrequently used words as compared with frequent; certain parts of speech; words that sound alike; closely associated words; complex sentences and logical sequence of sentences.

Productive disturbances reveal the aphasic individual's disabilities in the production and expression of ideas through the use of verbal or written symbols. A major subcategory in this class are patients (anomics) who have difficulty in evoking an appropriate word; the defect is evident in the effort to produce nouns (nominal words). The expressive difficulties may also manifest in reduced vocabulary, telegraphic speech, jargon, agrammatism, paraphasias, fluency changes, phonemic changes, word-finding difficulties and impairments in the formulation of written language symbols (agraphia).

Although many other classifications of aphasic syndromes have been proposed, this general grouping into receptive vs. productive behavioural deficits remains the most widely used. It should be noted that a patient may exhibit behaviors from both categories, and that the clinical picture may be complicated by such non-central language disturbances as difficulty with articulation (dysarthria) or by such global disturbances as a general cognitive or memory loss.

1.3 Relationship between the studies of aphasia and linguistics

The systematic study of aphasia began over a century ago, as far back as Wernicke (1874). Since then attempts have been made to link the fields of aphasia and language

studies. Wernicke (1874) attempted to define the 'receptive' and 'expressive' disorders of aphasic language in relation to the neurological components of the brain. This led to the establishment of the 'syndromes' or 'symptom-complexes', meaning the 'grouping of deficits'. Wernicke's main finding was that a defect in the neurological component of the brain in a given individual could be seen in terms of defects in language performance, as language performance is directly related to the functioning of the brain. However, from a linguistic viewpoint, aphasic speech can be considered to involve breakdown of the linguistic code, a disturbance of the relations between sound and meaning.

Linguists have attempted to investigate the problem of aphasia along several lines. Jakobson (1956), using a structural approach, tried to establish a linguistic framework to which to relate aphasic difficulties. He described two basic types of disorder: a selection disorder (similarity disorder) and a combination disorder (contiguity disorder), these being two extremes with varying grades of disorder between.[1] The similarity disorder refers to the difficulty in spontaneous selection or substitution of lexical (semantic) items; and the contiguity disorder refers

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[1]The similarity disorder results from the disruption of the syntagmatic process, and the contiguity disorder results from the disruption of the paradigmatic process. For example, in producing the phrase 'I saw a big...', syntagmatic mechanisms determine the sequencing of the construction and thus the occurrence of some nominal form (bear, house, plane, man, etc.) but the selection of what form (e.g., plane rather than any of the other possibilities) depends upon paradigmatic mechanisms.

to the severe difficulty in combining words into more complete constructions, in transforming structures grammatically (e.g., from active to passive, from present tense to past, from singular to plural), and in rhythmic and sequential performances generally. Jakobson proposed three dichotomies underlying the six types of aphasia described by Luria (1970). The first was an encoding-decoding dichotomy, referring to impairment in the mechanics of execution or comprehension. The second dichotomy was limitation-disintegration, referring to impairment in the sensory mechanisms; either the efferent motor system or the afferent motor system. The third, sequence versus concurrence, referred to the impairment in the mechanics of sequencing (constructing terms like 'father's brother') or the mechanics of concurrence (distinguishing terms like 'father's brother' and 'brother's father'). This type of labelling only gives a description of structural breakdown and a notion of how this might relate to preconceived types of aphasic speech, although Jakobson makes tentative claims about the relationships between his dichotomies and anatomical lesions. Further research fails to show how assessment of aphasic language may be carried out on the basis of his dichotomies.

Luria's neuropsychological approach (Luria, 1966, 1970) based on the 'functional organization' of the brain, tries to correlate the site of lesion with the specific behavior disorders related to it. Accordingly, Luria's investigations

are mainly neuropsychological in nature, and as such 'provides us with a factor analysis that will lead to better understanding of the components of complex psychological functions for which the operations of the different parts of the brain are responsible (1970, p. 66).' Luria's neuropsychological approach has been applied in therapy by Luria and Tzvetkova (1967). Here the therapy relates to the teaching of neuropsychological principles in language rehabilitation. This approach is different from others, for example, Lesser (1978), who emphasize the application of linguistic principles in speech and language therapy with aphasic patients.

The development of the transformational approach to language (e.g, Chomsky, 1965) has led to the application of transformational theories in the studies of aphasia, for example, Myerson and Goodglass (1972). As the transformational theories primarily deal with the abstract deep sturctures being transformed into surface structure aspects of language, the result of many such studies with aphasics has been to show the number of transformations retained or lost among aphasic patients.

The drawback of transformational theory as a basis for assessment of aphasia is that it does not primarily characterize grammatical structures in terms of meaning. It treats syntax as a closed, structured, autonomous system, to be described without reference to the cognitive or emotional status of an individual speaker. Hence the theory is not

easily utilized as a basis for devising a test for aphasia. Commenting on the limitations of transformational theories in explaining aphasic behavior, Lesser (1978) quotes Crystal et al. (1976) and writes:

> Crystal points out that the salient differentiating features of disordered syntax in speech are precisely those which are not readily describable in terms of transformational grammar. In particular, transformational grammar does not seem to be apt in the examination of comprehension difficulties at the syntactic level. The range of structures from those which present no difficulty to those which require a heuristic approach is so narrow in aphasia that a different theoretical framework of analysis is more useful; for the examination of comprehension which is necessary to throw light on the question of whether agrammatism in speech represents a central or an encoding disorder, the description of language in older structural terms has proved so far to be more practical. (Lesser, 1978, p. 143)

The transformational approach has been offered, however, as a method of characterizing the grammar of language. As Bresnan (1978) says 'the difficulty in linguistics is that we can characterize our knowledge of language in too many ways (p. 58-59).' Kean (1977), for example, considers the language faculty to consist of (1) a grammar which gives an account of a person's knowledge of the structure of his language and (2) the processor, which provides an account of how that language knowledge is exploited in use. In the light of these assumptions, Kean has discussed the problems faced by Broca's aphasics in expressing language for communication. According to Kean, Broca's aphasics mainly have a phonological processing deficit. However, such processing theories give a different

view of the study of language problems among aphasics.

As evidenced above, the linguistic characterization of language knowledge has been done in too many ways. The recent trend in linguistics has been to a characterization in terms of structures at the surface level and the movement of meaning into a more central role. This has resulted in the emergence of a functionalistic viewpoint which describes the surface linguistic structures in terms of the function they signal (Dik, 1978; Prideaux, 1979). The value of such studies highlights the point that there is no need to call upon abstract and intrinsically non-testable structures which do not yield to psychological verification.

In general, the linguistic subdivisions that have been applied in the analysis of aphasic language are traditional: phonology (prosodic, phonetic, and phonemic), syntax (transformations, syntactic structure, case relations), semantics (syntagmatic sense relations, paradigmatic sense relations or lexical semantics) and communication (verbal structure of communication and non-verbal communication) (Lesser, 1978). Such studies do not suggest any remediation procedures from a clinical viewpoint. However, the majority of the studies establish the idea of aphasia as the reduction of availability of language rather than as a total loss of language.

In addition to the descriptive lingusitic studies, psycholinguistic models of aphasia have been proposed by

Wepman (1960)[2] and Osgood (1963[3] and 1980) to explain the nature of aphasic deficit. These psycholinguistic models are primarily concerned with those (decoding) processes whereby messages are received and interpreted and with those (encoding) processes whereby messages are articulated. As such, these models view aphasia more as a testing ground for their theories than as a problem to be understood for therapeutic purposes.

The Wepman model (1960) stresses a modality-bound separation of transmission at every level for both input and output, the important role of recall in all phases of perceptual and conceptual language, and the role of both internal and external feedback. The model separates the decoding from the encoding processes. It distinguishes a meaning or symbolic level from a level of more automatic sequencing of language materials. According to Wepman, a disturbance in the input and output modality transmission refers to agnosia (on the decoding side) and apraxia (on the encoding side). A defect in the symbolic process is referred to as aphasia. Whether Wepman's modality distinction can be separated at all levels is really questionable. There is no clinical evidence to support Wepman's claim that an integration level can be intact even if the decoding and encoding processes are impaired.

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[2]See Wepman, Jones, Bock and Van Pelt, 1960.
[3]See Osgood & Miron, 1963.

Osgood's (1963 and 1980) approach aims to describe the psycholinguistic processes impaired with aphasics. His approach is based on the multistage model of language behavior which assumes 'that a stimulus producing response mediates between observable S and R, yielding a two-stage S-r-s-R process.' Accordingly, the aphasic patient's deficit can be differentiable into (1) decoding versus associative versus encoding disturbances and (2) into disturbances reflecting mainly semantic or grammatical aspects. It is questionable, however, whether the demarcation between the levels of Osgood's model can be discriminated clinically or shown empirically.

In contrast to linguistic theorizing, the psycholinguistic models have tried to account for the disruption of language processes. Based on these models tests have been developed for assessing aphasic language performance. These tests will be discussed in Chapter Two.[4]

However, the present theoretical linguistic contributions to the study of aphasia have not as yet contributed in a major way to the understanding of the deficit. This thesis will suggest that, in assessing aphasic speech, language must be considered as a functional system, divided so that individual aspects can be studied, but in whole as a model incorporating all aspects of communicative competence. Linguistic assessment on such a theoretic base

[4]The Illinois Test of Psycholinguistic Abilities (McCarthy & Kirk, 1968) based on Osgood's model will not be discussed as it is not primarily meant to be a test for aphasia.

as this is a requirement for the exact nature of the disorder to be understood.

> In this overall approach to linguistic assessment, communicatory competence involving language must be considered fundamental. There are two dimensions of assessment: one involves an intelligibility criterion, which deals wtih specific components of language such as semantic, syntactic and phonological features. The other dimension deals with appropriateness and adequacy (Vantreen, 1975, p. 139).

This aspect of the 'communicatory competence' has not been referred to adequately in the majority of assessment procedures. Communicative competence, according to Vantreen (1975) involves metalinguistic and paralinguistic features of communication. Social factors such as age, sex, and education have to be considered. In assessing aphasic speech it is important to realize which functional features are more important for an individual and which features would deprive him most, by their absence, in his day-to-day living.

Linguistic assessment of aphasic speech has been confined to specific levels of language description, namely, phonology, morphology and syntax. For a complete assessment, an individual's language knowledge must be considered in all aspects of its use. Procedures at present are very lengthy as regards the standardized testing techniques. Discussing the problems of aphasic language; MacMahon (1972) suggests that:

> In order to analyze a language system the linguist needs an initial criterion to assess language disorders against if ever there is to be an agreement on assessment procedure. The first is that if aphasia is defined as a language disorder, then analysis of the condition by the scientists concerned with language, the linguists, is a priority. Everything else stems from it - the classifications, the neurological theories of localization and treatment (p. 54).

Observations of aphasic behavior are often used in theorizing about normal language processes (Lenneberg, 1967); in consequence, a change in views about the nature of aphasia would seem to have some significance for the study of normal language processes of comprehension and expression. In general, linguists have been unclear about an appropriate role for themselves in the study of aphasia. Should they aim at applying linguistic insights about normal language to the development of diagnostic tools or the direction of therapeutic procedures? Or should they consider the data base of aphasic utterance for further insights about the normal state? It will be the contention of this thesis that the two aims are not mutually exclusive, and that the linguist working in a productive theoretical framework can combine them to the benefit of both.

1.4 Aim of the thesis: development of a linguistically based standardized test for aphasia

Testing in the field of aphasiology has attracted considerable interest in recent years. Standardized testing is a prelude to establishing accurate classification as a

basis for research and treatment. The qualitative measurement of language disorders is important and necessary, for only with such measurements it is possible to compare one individual with another. The present study aims at the development and clinical validation of a standardized psycholinguistic test for aphasia, based on the Information-Structure model of language description developed by Prideaux (1975, 1978, 1979) and Baker (1976). A description of aphasic language based on performance on this test will refer to 'levels of language impairment and levels of language function (Martin, 1977).' The focus of the present study is both on providing a tool for the speech pathologist who is responsible for establishing a differential diagnosis of adults who have some type of communicative problem secondary to brain damage, and on assessing the Information-Structure model of language description against a new (non-normal) domain of language behavior.

Differential diagnosis with brain-damaged patients manifesting language difficulties is a necessary adjunct to medical assessment, for it helps to determine whether speech and language therapy is recommended and to determine what kind of treatment is appropriate. For example, treatment for an aphasic patient involves language training, whereas training for the patient with apraxia of speech might involve drill in phonetic or motoric speech (Halpern, 1978). If aphasia is defined on a linguistic basis, then assessment

should follow the linguistic criteria. Not all tests employ specific language models, despite the explicit purpose which the tests are meant to serve.

> Tests are no more than tools. They assist in finding out what the patient has to tell about his problems. They guide and act as a mirror to the patient's behavior. As such any test must represent the best responses a patient can make within the context of the testing situation. Test results should be prognostic in nature (Wertz, 1977, p. 61).

In this study, the aim is to develop a test, the results of which will indicate diagnostic and prognostic factors regarding the individual's performance. That is, the test aims at the description of the performance all along the different information levels as given by the Information Structure model and the test results may not deal with 'how the levels are being processed.' With this main consideration, the psycholinguistic test developed here is thought to be sensitive (to measurement of the residual language skills of the subject), precise (in eliciting the same information consistently, by various techniques), and objective (in consistently assessing comparably across individuals).

The psycholinguistic model upon which the test is based is one which concerns itself with the mapping of functions (meanings) into structures (utterances), rather than with the categorization of utterances by structural type. Since aphasias are disruptions of the language use, the application of such a linguistic model has quite obvious

advantages.

1.4.1 Need for a linguistically based test: a clinician's and a linguist's view

The major emphasis on the linguistic considerations in standardized testing rests on the fact that speech therapists deal with language, and linguistics is the study of language. 'If one of the major tasks of the speech therapist is the diagnosis of the patient's problems, then he has to consider a test that is linguistically oriented (Pincas, 1965).' Traditional attempts to classify aphasic language disturbances have been largely from a neurological viewpoint and hence descriptions such as jargon aphasia, telegraphic speech, motor vs. sensory aphasia, reading difficulty, nominal aphasia, etc. have not been found satisfactory. Linguistically, these terms are not particularly significant in describing aphasic's behavior, being more useful as labels.

According to Pincas (1965) the two main uses of linguistics in the field of aphasia are for analysis and rehabilitation. In terms of analysis, the linguist faced with an aphasic patient should investigate the defective language on all language levels systematically, and the findings of such an analysis should provide the basis of rehabilitation therapy. In the area of rehabilitation,

> Hitherto, approaches to teaching have either ignored the importance of a system and relied on psychological stimulation (e.g., group conversation, family encouragement) or have organized according to psychological rather than linguistic criteria (e.g., emphasizing topics related to the patient's pre-morbid interests), and where there has been a linguistic criterion it has been semantic (e.g., the association of vocabulary around a common theme such as part of the body, or around a common word such as "coffee" in "coffee-pot", "cup of coffee", etc). In general, teaching has shown a curious contradiction between optimistic reliance on spontaneous recovery on the one hand and, on the other hand, in the absence of spontaneous recovery, lack of sufficient optimism to undertake a systematic programme of instruction proceeding slowly, perhaps over years, with a chance of eventual recovery (Pincas, 1965, p. 23).

A linguistic contribution to aphasia can serve two complementary purposes, as noted by Blumstein (1973)[5]. First, it may help give some insights into the nature of language disorder. As aphasia is a disorder of language, a linguist may be best equipped to consider the intricacies of the linguistic system, its organization and the most reasonable means of analysis. Secondly, aphasia offers the linguist a testing ground for theoretical linguistic assumptions. Linguistic theory makes certain claims about the theoretical constructs of language and their subsequent organization. 'Empirical verification of linguistic theories is of obvious necessity. Thus, research in aphasia may help to give some insight into the structure of language parameters and their subsequent organization, into the unity-language (Blumstein, 1973).' Such an intersection between the two fields, viz., aphasiology and linguistics,

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[5]See Goodglass & Blumstein, 1973.

is supported by Grewel (1963), Green (1970), Pilch (1972) and Marckworth (1976).

Within the linguistic study of aphasia, the psycholinguistic aspect deals with the relation of linguistic structures and the function they signal. One recurrent image of aphasia presents it as a testing ground for psycholinguistic theories, a kind of track on which the latest model can be given trial runs (Osgood & Miron, 1963). Here Green (1970) assumes that the models themselves, usually drawn up from elsewhere and designed to explain normal behavior, can be tested out on aphasic patients. However, the present testing methods on aphasia are ill adapted to providing data for a psycholinguistic analysis, in as much as they almost exclusively point up word-finding difficulties, that is to say, disturbances in the lexical paradigm. Object-naming or action naming tells us little or nothing about the status of syntactic ability. Although many standardized test batteries mention the need to observe the patient's spontaneous speech, only very simple instructions are given for its evaluation.

Considering the above pitfalls, it is evident that the research of a psycholinguist in aphasia should be directed towards the three goals suggested by Green (1970). These are: (1) to define and account for the significant characteristics of aphasia in its different forms; (2) to point to the relevance that findings may have for the speech behavior of normals; and (3) to suggest principles and

procedures that would be most useful in rehabilitating the aphasic patient (p.217).

1.5 Linguistic aspects of testing: the current status

In recent years, attempts have been made to define aphasic types qualitatively and quantitatively according to performance on certain tests (Schuell, 1965; Wepman & Jones, 1961; Goodglass & Kaplan, 1972), although many clinicians have classified aphasic impairments based on clinical impressions (unmeasured performance).

The majority of standardized tests do not account for the inconsistencies noted in the behavior of the subject, who may function quite well in the real world, but perform poorly on tests in a clinical setting. In the area of language assessment of the aphasic patient there is an inadequate evaluation of his functional language abilities. Sarno's (1969) Functional Communication Profile (FCP) and Holland's (1980) Communicative Abilities in Daily Living (CADL) are the two tests designed to assess the aphasic patient's functional language ability. The FCP and CADL both provide information about how a patient interacts with others in a testing situation. The FCP evaluates functional language ability using a rating scale. The CADL is interested in measuring how well a patient converses, as performance is generally better in conversation than on tests. Such a dimension of measurement is not included in

all existing standardized tests.

Most clinicians and researchers have focussed greater attention on the verbal aspects of the behavior of aphasic patients. Despite persistent observations by a number of investigators, for example, Duffy et al. (1975), that aphasic patients also demonstrate impaired communication in the use of signs, gestures, pantomime, mimicry and other nonverbal behaviors, not much attention has been directed towards including the nonverbal aspects of communication in the standardized tests. Only Porch (1967) has included two pantomimic subtests in a battery used in the evaluation of the aphasic patient. Here, the absence of a more vigorous interest in the nonverbal communicative strengths or deficits of aphasics is surprising when one considers the important theoretical and clinical implications of such data. Theoretically it means that non-verbal tools are an aspect of the communicative system, as they express ideas; clinically it means that non-verbal tools can supplement verbal tools in therapy.

Analysis of spontaneous speech has received considerable attention in the recent studies concerning diagnosis and classification of aphasic patients (Benton, 1967; Goodglass & Kaplan, 1972; Wagennar, Snow & Prins, 1975), because disruption of spontaneous speech is normally the most distressing symptom of aphasia, and often the first observed. These studies suggest that spontaneous speech production is also important theoretically and clinically,

because it provides the most subtle and complete reflection of language abilities of aphasic patients, when analyzed in a sufficiently detailed and linguistically interpretable manner. However, such an analysis has so far remained as a 'research study' and no attempts have been made to include it in the standardized tests on aphasia.

The majority of the standardized tests on aphasia do elicit information on the comprehension abilities of the aphasic patients. Recent work on comprehension by Bransford and Johnson (1973) has dealt with an aspect of comprehension of extended phrases or even paragraphs in a given context. Bransford and Johnson's research clearly demonstrates the extent to which the provision of an appropriate context facilitates the decoding of a complex verbal message in a group of normal subjects. The importance of context in the comprehension of sentences by aphasic patients has been discussed by Goldstein (1948) and Goodglass et al. (1980). A research study by Stachowiak et al. (1978) attempts to employ the concept of 'context' in comprehension testing. The results of their study offer some useful information about the ability of aphasic patients to use redundant information in understanding single words. Here, Boller et al. (1977) suggest that it might be possible to explore the performance of aphasic patients with severe comprehension deficits by systematically using verbal stimuli in situations approaching normal communication and by carefuly noting the patient's responses even when his actual language

performance is quite defective. This approach agrees with Goldstein's (1948) and Sarno's (1969) observation that 'often patients who are unable to perform correctly in a test situation are able to perform normally on the same task in real-life situations.'

Brookshire and Nicholas's (1980) study using a 'sentence verification task' substantiates the fact that aphasics can perform better on tests based on general knowledge that involve daily life activities (for example, recognition of active and passive sentences). Because under normal communicative situations, language comprehension requires the understanding of words, sentences and the processing of connected chains of utterances, that is of discourse or text. To construct the content of a text, the semantically most relevant constituents and their relationships must be stored and remembered (Stachowiak et al.). In understanding utterances the comprehension process must be aided by processes of inference, deduction, and problem solving which are related to the verbal and situational aspects of a given discourse, because for the hearer to understand the information being conveyed, he has to contextualize both verbal and situational aspects of the discourse (Fillmore, 1974).

> The term verbal contextualization is used here to denote the hearer's reconstruction of the text with regard to the semantic and pragmatic relations given within the text. Further, in order to contextualize a situation, the hearer incorporates information provided by the situation in which the text occurs and to which the text refers.

> Understanding is achieved when verbal contextualization matches situational contextualization (Bransford and Johnson, 1973, p. 120).

In the field of aphasiology, it is evident that the lexical and grammatical aspects of language can be differentially affected in comprehension deficits (Goodglass, Gleason & Hyde, 1970; Parisi & Pizzamiglio, 1970; Shewan & Canter, 1971). Based on Fillmore's concept, Stachowiak et al. hypothesize that the main source of aphasic deficit in the comprehension of conversational language may be a specific impairment in contextualization rather than a pure lexical and/or grammatical impairment or a disorder of basic linguistic abilities. There is another possibility, namely, that contextualization remains intact and that the more redundant situational and verbal information given in conversational language compensates for a disorder of basic linguistic abilities, which are assessed by the usual subtests of any aphasia examination. This aspect of 'context' is not included in all comprehension tests on aphasia.

Most tests on auditory comprehension require a 'yes/no' answer by voice or gesture to a series of graded questions. This type of response may present difficulties to some aphasic patients, who may say 'yes' when they mean 'no', and vice versa (Critchley, 1970). Auditory comprehension may be better evaluated if the patients designate by pointing to objects named by the examiner, or obey simple verbal instructions. As Goodglass, Gleason and Hyde (1970) suggest

evaluations of comprehension typically treat the notion as a single entity. The usual description states that the patient's comprehension is *good*, *fair* or *poor*, whereas descriptions of speech are often much more specific, e.g., 'he has difficulty naming objects' or 'he can only respond with single words.'

Thus, based on the several issues raised by the research studies on comprehension testing (Parisi & Pizzamiglio, 1970; Stachowiak et al., 1977) and as stated by Boller et al., (1977) it appears that a test of comprehension must involve the following stimulus factors: (1) a means of comparing a subject's response to single words with his response to more complete, 'natural' utterances, the latter with and without redundant, associated cues as to the meaning of the utterances; (2) the presentation of utterances both independent of and within a context; (3) specific testing for receptive language abilities, containing various levels of linguistic difficulty in order to discover subtle receptive language disturbances without the use of obscure vocabulary and syntax; (4) no use of tasks or commands necessitating extensive memorization; (5) the presentation of utterances at both slow and natural speeds (Albert & Baer, 1974; Gardner et al., 1975); and (6) presentation of repeated trials (Green & Howes, 1975). In addition, the subject's responses have to be evaluated in terms of both correctness and appropriateness (Boller & Green, 1972).

Besides the lengthy tests for aphasia, there are some short tests (Schuell's Short Term Examination for Aphasia, 1957; Schuell-Sasanuma Examination for Aphasia, 1976; Sklar Aphasia Scale, 1966; and Orzeck Aphasia Examination, 1964). These short tests for aphasia are primarily used for screening purposes. Schuell (1966, p. 277) suggests that these short tests for aphasia cannot be completely satisfactory for the following reasons; Firstly, a short test may not evaluate the aphasic behavior in all language modalities. Secondly, a short test may not specify major areas of disability. It may not explore aphasic behavior within each language modality to determine why performance breaks down when it does. Thirdly, a short examination may not be reliable as it fails to elicit an adequate sample of aphasic behavior from many patients for whom most of the tests in an abbreviated scale may be too difficult. Generally, test reliability is considered as a function of test length and length becomes particularly important when fine differential diagnosis is desired. However, a lengthy test can be boring or tiring to the patient taking the test.

In the evaluation of language impairments, the problems faced by the clinician relate to the interpretation of responses. Responses depend on several variables, among which are the range and difficulty of the test tasks selected and conditions under which they are administered. Testing situation has been cited as an important variable by Taylor(1965). Performance observed in natural situations can

differ markedly from that elicited through formal testing. Spreen and Wachal (1976) emphasize that 'in aphasia testing it is necessary that the patient produce limited standardized language samples (e.g., the name for ten pictures) or understand standardized stimulus material (e.g., read the text on printed cards, etc.)' to make the responses amenable to linguistic analysis.

The most widely used aphasia tests are actually test batteries comprised of numerous subtests of many discrete verbal functions. Their product is a 'score or an index' for diagnostic purposes. Such standard test scores are meaningless when dealing with aphasic populations which are heterogeneous in age, intelligence, cultural milieu, medical history, locus and extent of brain damage, and severity and duration of aphasia (Schuell, 1965). The most important reason for rejecting standard scores is that they yield no information about the qualitative nature of linguistic interference with performance on individual tests or about the over-all pattern of language impairment in aphasia. It follows that the most effective way of interpreting test data is in terms of clinical signs and total test pattern. As Schuell admits:

> It is necessary to ask not only how many but what kinds of errors a patient made on a given task. It is possible to describe patterns of aphasic impairment in terms of test profiles that reflect quantitative errors, but it is more meaningful to describe the performance of an individual patient in terms of the kinds of errors he makes or clinical signs (1965, p. 7).

Such profiles give an orderly and visual description of the patient's communicative disabilities. Profiles also provide an objective method by which clinicians can evaluate changes that occur during the course of therapy, and can serve as an instrument for longitudinal studies.

Porch (1971) suggests that the problem of scoring is critical as the instrument has to describe the nature of the patient's responses to the tasks with high reliability. Obviously, regardless of which tasks are selected, and how the administration procedures are standardized, the effectiveness of the scores is limited by the sensitivity and consistency of the scoring method (Goodglass and Kaplan, 1972). The standard scores do not objectively and automatically classify the patient nor point to the optimum approach to therapy as they mainly tend to be quantitative in nature, and their interpretations depend upon the experience of the examiner.

> In fact no test battery is confident to claim to classify by objective scores; and classification always ultimately rests upon the assessor's qualitative estimate which must inevitably reflect not only the clinical experience he has had but the theoretical preconceptions which he holds (Lesser, 1978, p. 19).

Thus, the major problem of interpreting the test results and their overall scores still stands unresolved. Clinicians are in need of better methods than the use of 'standard scores'.

As it is evident from above, standardized tests on aphasia have not overcome all the problems cited by many researchers in the field. Such test results have not

indicated the therapeutic procedures based on linguistic viewpoints. Consequently, speech therapists employ a general approach in the treatment of language disordered patients. Irrespective of the need for the development of adequate tools for the diagnosis and treatment of aphasia, a need is felt to observe and record aphasic behavior empirically, and to do so in the framework of a linguistic model which concerns itself with language as a psychological process, i.e., which includes as its subject matter language structures and the relationship between them.

1.6 The Information Structure model of language

1.6.1 Description

The Information Structure[6] model of language proposed by Baker (1976) and Prideaux (1975, 1979) is psycholinguistically oriented and it accounts for the description of linguistic forms at the surface level along with the functions which these forms signal. Illustrating this aim Prideaux (1979) says:

> Chomsky and others have asserted, however, that linguistics is not an autonomous discipline, but rather a branch of cognitive psychology. If that assertion is accepted, then one is forced to construct a grammar which can be given psychological interpretation. It is useful, therefore, to address the question of grammatical description from another point of view. Suppose one is not interested in treating language as simply a

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[6]This term is not the same as the one used by Shannon and Weaver (1949) in their 'information model'.

> formal object, but rather, from a psycholinguistic perspective, in considering the functions to which the language is put (p. 124).

Considering the above aim, the Information Structure model of language relates structures to function. The model views language in the first place as an instrument of social interaction between human beings, used with the primary aim of establishing communication relations between speakers and hearers. As Jespersen (1924) wrote:

> The essence of language is human activity--activity on the part of one individual to make himself understood by another, and activity on the part of that other to understand what was in the mind of the first. These two individuals...the speaker and the hearer, and their relations to one another should never be lost sight of if we want to understand the nature of language and of that part of language which is dealt with in grammar. But in former times this was often overlooked, and words and forms were often treated as if they were things or natural objects with an existence of their own (p. 17).

Thus the fundamental assumption underlying the model is as follows:

> The basic function of language is to convey various kinds of information, and the grammar of a language is a specification, first, of the kinds of information to be conveyed and second, of the linguistic devices used to convey such information (Prideaux, 1979, p. 125).

In a communicative event, the intended message (m) is thought of as a cognitive representation consisting of four parts: (1)Denotational information, Id; (2) Relational information, Ir; (3) Sentential information, Is; and (4) Contextual information, Ic.

1.6.1.1 Denotational information

> Denotational information (Id) refers to the information conveyed by the lexical items plus the expansion, delimitation, modification, etc. of such lexical items in particular sentences. The various choices within a noun phrase such as determiners, number, and such modificational structures as adjectives, relative clauses, and the like are instances of denotational information associated with a nominal. The denotational information of the predicate, Dp, refers to choices from among tense, modality, aspect, locatives, polarity (positive or negative), emphasis and the like. The linguistic devices used to signal such denotational information for the predicate include the use tense affixes, aspectual and modal auxiliary verbs, prepositional phrases, and subordinate clauses (Prideaux, 1979, p. 130-131).

The denotational information also includes the connotative or affective qualities which a term may acquire in a given linguistic community or for a given speaker or hearer.

1.6.1.2 Relational information

Relational information consists of the relationships which exist among the units of the message 'm'. As such,

> Relational information (Ir) refers to the various grammatical (not case) roles played by constituents in sentences. Such roles include subject (SUBJ), direct object (DO), indirect object (IO), subject complement (COMP), and of course the verbal pivot material, the predicate (PRED) (Prideaux, 1979, p. 129).

The relational information specifies the unique grammatical function associated with each nominal and this in turn is given linguistically by such devices as word order (in English), morphological affixation, or other typical, language-specific linguistic devices in a variety of languages.

1.6.1.3 Sentential information

> Sentential information refers to the sentential mood of a particular sentence. For the main clause of a sentence, the choices available for Is are the familiar Declarative, Interrogative or Imperative. The linguistic devices associated with each sentence type involve constituent orderings, morphological affixation, and intonation (Prideaux, 1979, p. 128-129).

The interrogative sentences include yes/no questions and wh-questions.

1.6.1.4 Contextual information

The term contextual information refers generally to what has been linguistically established prior to the use of the particular utterence under consideration. A context is created by all of the utterances which preceded the one being interpreted.

> Contextual information (Ic) specifies the relative importance or saliency of certain constituents of a sentence and includes such aspects as the topic and focus of the sentence, as well as the distribution of given and new information. The linguistic devices in English for indicating the topic include the placement of a topic NP in clause-initial position, while focus is indicated by the highlighting of a constituent or part of constituent with contrastive stress (Prideaux, 1979, p. 128).

Although contextual information is realized within sentences, the source of, or reason for, such phenomena may indeed be found in the context in which the sentence is uttered. Here the term 'context' refers to the verbal context strictly.

This Information Structure model should not be confused with the Information-Processing model developed by

psychologists (Lachman and Lachman, 1979). In the latter, the Information-Processing paradigm refers to the study of

> ...the way man collects, stores, modifies, and interprets environmental information or information already stored internally.. The Information-Process paradigm is interested in knowing how an individual adds information to his permanent knowledge of the world, how he accesses it again, and how he uses his knowledge in every facet of human acitvity..... The Information-Processing model deals with collection, storage, interpretation, understanding, of environment or internal information (Lachman, Lachman and Butterfield, 1979, p. 7-8).

The Information-Processing model deals with "how" information is processed, but the Information Structure model deals with the characterization of types of linguisitic information. The Information Structure model does mention that linguistic devices are communicated through the processes of comprehension and expression. However, the model as a framework does not specifically deal with the 'processing' aspects of communication.

1.6.2 Strengths as a basis for a test

The Information Structure model of language has emerged as a result of experimental psycholinguistic work in establishing a conceptual framework for describing the forms of language (knowledge of the coding system) together with the functions these forms signal. The Information Structure model treats meaning as the chief determinant factor in communication. As a psycholinguistic model, it accounts for language data which come from language behavior, and as a psycholinguistic tool, the Information Structure model of

language mainly aims at the description of the relationship between forms and function (relating meaning and the elements for coding that meaning).

The Information Structure model provides a perspective on language by means of a taxonomic system for the inventory of aphasic behaviors. The model is more perspicacious regarding aphasia than a levels-of-representation model. While the Information Structure model does not necessarily make different predictions from a levels of representation model, it does provide a useful basis for therapy. This is evidenced by the taxonomy of message type, which starts with the description of function rather than with form. A coding specification follows, forming a linguistic rule that describes syntactic forms at the surface level, paired with information units to produce the grammatical description. Such a description thus describes what forms occur and how these forms signal meaning. For example, the direct object rule given by Prideaux (1979) states a simple generalization that in a non-Wh form (e.g., Jason has sent the fleece to Theseus, NP Va V NP(DO) to NP) the direct object NP is ordered to the right of the main verb (V).

The Information Structure model emphasizes the meaning which is attached to forms, because sentences cannot be comprehended independent of the use of language. In a communicative situation, (1) speakers intend to evoke a specific kind of reaction; (2) hearers interpret the language they hear; and (3) a message will be communicated.

Language is a tool for communication, with words and sentences used to transmit meaning. Thus description of language structures without their associated meanings is hardly a description of language. Because the language system is embedded in a cognitive system, both verbal and non-verbal tools help to convey the cognitive ideas in the communication process. Many times the medium through which communication takes place involves paralinguistic features (gestures and pantomime). This meaning is derived in part from the knowledge of the world, situational variables, which form a context for the use of the message units. However, linguists and aphasiologists are primarily interested in the verbal aspect of the context.

The merits of the Information Structure model of language lie in the theoretical assumptions on which it rests. The assumptions are that a language model should relate (1) to the study of language behavior; (2) to the study of both and speaker and hearer's language and (3) to the study of language acquisition. From a speech pathologist's point of view it should relate to the study of pathological language and the field of aphasiology offers scope for the verification of this assumption. As mentioned in the earlier sections (1.2 & 1.4), the literature reveals many attempts to connect aphasiology and linguistics. The literature also reveals a great many reflections of lack of unity between the two fields.

Benton (1967) suggests there is an important conceptual problem in assessing aphasic language. This problem is due to the fact that there is no appropriate model of language which can be tested. But, for Bresnan (1978) there are too many characterizations of language knowledge, for example, Chomsky (1965) and Kean (1977) and there is no principled basis for choosing between them. Experimental investigations alone can tell which model can be useful in describing normal and aphasic language behavior. It is apparent that linguistic assessment of aphasic speech has to be based on a language theory. But 'what sort of language theory is appropriate?' is the logical question that arises. Language theories that only describe structures give us no insight into the actual functioning of a linguistic system, and consequently, are of little help in assessing where that functioning may have gone wrong. If linguists can describe the psychological aspects of language by way of a psycholinguistic theory, then a test based on that theory should provide some insight so that the pathological processes can be decribed and understood.

A test should act 'as a evaluation technique and as a valid research technique (Benton, 1967).' Such an aim can be fulfilled when the test is based on a theory of language which addresses itself to language as a process. Luria (1976) has also emphasized the importance of a new psycholinguistic test. According to Luria (1976),

> Communication is a direct reflection of the thought processes involved. Any coherent fragment of a text is not merely a sequence of sentences but it incorporates a general thought, a conclusion drawn from the communication as a whole. (p. 42)

Luria (1976) stresses the importance of new ways of investigation of these highly complex processes of encoding and decoding communication, because 'such methods may be capable of distinguishing the component parts of this process and of describing their role in the formation and understanding of verbal expressions.'

This study suggests that framework for such a psycholinguistic test for aphasia stems from the Information Structure model of language. Here, the proposed information level hierarchy correlates with data found in the available aphasic literature. As described by Jakobson (1956), even the most severe aphasics do retain some amount of propositional speech. This correlates with the denotational level of information. On the receptive side, it is evident that aphasics find it more difficult to understand contextual information when compared to denotational information. An aphasia test which provides this sort of information also provides a tool to the speech therapist, who can use the results to assess the level of the patient's performance and start therapy from that level onwards.

1.6.3 Reciprocal value

Development of a psycholinguistic test has valuable reciprocal information to offer to the Information Structure model of language. First, it will help to validate the model as broad and general enough to include a description of the pathological language data as well as normal. Second, it will help to investigate the validity of the proposed information level taxonomy, and suggest whether the levels form a hierarchy. Third, it may suggest modifications of the psycholinguistic model of language. Fourth, it may suggest possible answers to questions about the processes of language comprehension and production. More specific examples of this sort of reciprocal advantage will be found in the discussion of results in Chapters Five and Six.

1.7 Statement of the explicit questions

The present study aims to answer the following questions which have emerged from attempts at designing an adequate test for aphasia over the past three or four decades.

1. What is the behavioral nature of language impairments and the levels at which these impairment occur in aphasia?

   Here the nature of language impairment is to be determined by the performance of aphasic patients on the psycholinguistic tasks incorporated in the test.

2. What is the performance of normals and controls (brain-damaged nonaphasic patients) on the proposed test?

   This question has greater relevance to the normative aspects of the test data because the present study aims at the development of a 'new' test.

3. What is the validity of the Information Structure model (Prideaux, 1979) as a description of language behavior in explaining aphasic performance?

   This question aims at defining the intersection of aphasiology and linguistics; it further reflects the utility of aphasic data in validating theoretical linguistic propositions and the theoretical model explaining the aphasic language behavior.

4. What assumptions can be drawn from the test about the nature of language impairment among aphasic patients?

   It is evident from the present knowledge about aphasics that they have expressive and receptive problems depending on the site and extent of brain damage. Some aphasics with expressive difficulties are not able to express an idea verbally; however, they can often express the same through gestures or pantomimes. Under such conditions it is possible that aphasics have retained the 'cognitive component' but have only lost the linguistic devices to convey the ideas. Such a consideration will add new approach to therapy. Teaching the patient how to establish the linguistic

tools would be different from teaching the 'concept' again. Here, the assumption is that language behavior entails different aspects, namely; cognition and message composition. The cognitive aspect relates to the situational variables and knowledge of the world. The message composition relates to the expression of ideas by means of linguistic devices. In instances where the linguistic devices are impaired, extralinguistic features like gestures and pantomime can reflect the 'cognitive' aspect (Schlesinger, 1977). Thus performance of aphasic subjects on nonverbal tasks adds light on the hypothesis that expressive aphasic patients may have lost only the verbal devices to convey the ideas.

5. How can the test results be incorporated in rehabilitating aphasic patients?

Based on the performance of aphasic subjects on this test, it is hoped to describe the nature of language behavior on the four different components of language viz., denotational, relational, sentential and contextual, as given in the Information Structure model. Training the aphasic subject on the expression and comprehension of different levels of information, starting from the one which he retains most, would be an ideal procedure.

1.8 Overview

In this Chapter I have attempted to lay the groundwork for the task to be attempted in this study. Chapter Two presents a brief summary and critique of existing tests from a historical aspect. Chapter Three discusses the experimental studies and highlights the general considerations of test construction, type of test tasks, and validation studies. It also provides a brief review of relevant information from research studies in aphasia. Lastly it summarizes the major issues discussed.

Chapter Four discusses the methodology involved in the study. The first part of the methodology relates to the development of the test tasks. The second part relates to the clinical validation of the test, giving details of the experiments (testing procedures) including the subjects tested and variables considered. Chapter Five involves the details of the data collected together with the results. Chapter Six summarizes the results of the study and their implications, and suggests trends for future research.

2. HISTORICAL REVIEW

In the area of testing and diagnosing aphasia, there are today many standardized tests for use by clinicians. These tests range in magnitude from the simple screening test to the more elaborate diagnostic examination. Early test batteries and resulting classification systems of aphasic language data have been followed by attempts to devise a systematic means of evaluating language behavior of aphasics in the light of current neurologic, psycholinguistic and linguistic concepts of the disorder. Reviews of the standardized tests are given by Wepman and Jones (1961); Critchley (1970); Emerick (1971); Eisenson (1973); Schuell (1974); Brookshire (1978); Halpern (1978) and Peterson & Marquardt (1981) in their books. Besides this, the individual tests have been widely reviewed; for example, the Language Modalities Test for Aphasia and the Minnesota Test for the Differential Diagnosis for Aphasia (Rigrodsky, 1972); the Token Test (Noll & Berry, 1969) and the Porch Index of Communicative Abilities (Martin, 1977).

Against this background, a review of the tests developed on aphasia is discussed here under the following headings:

1. A brief summary and critique of existing tests.
2. General considerations of test construction, test tasks

and validation studies.

3. Information from research studies in aphasia.

Sections 2 and 3 will be discussed in the next Chapter.

2.1 A brief summary and critique of existing tests

2.1.1 Earlier tests

Henry Head's assessment procedure is considered a landmark in the examination for aphasia. Head's test (1926, 1963, Vol.1, p. 142-165) represents a systematic procedure for assessing aphasic impairments and thus includes testing and retesting of a function in graduated sequences and in several different ways through different modalities. Head's serial tests on aphasia included the following: naming and recognition of common objects, naming and recognition of colour, the man, cat and dog tests (for testing logical relationships), the clock tests, reading tests following directions of a numerical and spatial nature, writing the alphabet in sequences and arranging the letters in sequences. Administration of Head's tests took too much time and many of the procedures were confusing as well as boring. But they represent what Head considered relevant to determining the presence and degree of symbolic formulation and expression as manifest in speaking writing and gesture.

Weisenburg and McBride (1935, p.91), in commenting on Head's tests, say: 'As to their value in differentiating the

aphasic from the normal, the simpler tests were satisfactory, while the more difficult tests are not, for the latter require complex performance in which many normal persons are not altogether successful. These more difficult tests can not be used satisfactorily without normal performance, both qualitative and quantative, which Head did not obtain.' However, the detailed description of Head's test provided the background for many of the procedures used today.

Weisenburg and McBride's Test (Weisenburg & McBride, 1935) was developed as a detailed study of the language disturbance to arrive at a 'qualitative analysis of the performance enabling the examiner to study the relative importance of the specific speech defect and other changes, the patient's method of work, and so forth (p. 139).' The principal tests used in the Weisenburg and McBride battery are the following: speaking tests (which include records of spontaneous speech and reactive responses), naming of standard objects, tests for understanding the spoken language (which include responses to everyday questions and comments, following directions, and comprehension of spatial terms and relationships), tests for reading (word-pronounciation test and oral reading of paragraphs), writing, arithmetic and non-language tests. However, this test is no longer in current use owing to its lengthy administration time.

Chesher's test (Chesher, 1937) was created as a screening instrument to evaluate aphasic patients by making use of a small set of the following common objects: key, pencil, hammer, button, scissors, and comb. Subjects were directed to name the objects, read aloud their printed names, write the names, point, repeat, copy the names and spell the names of the objects. As Chesher's examination did not investigate the total language disturbances in the aphasic patient, it was not used widely.

The Goldstein-Scheerer tests (Goldstein & Scheerer, 1941) constitute an inventory of psychological procedures meant to assess quantitative and qualitative changes in intellectual functioning in brain-damaged persons with specific reference to abstract and concrete reasoning. The test tasks were derived from Goldstein's concept that the aphasic patient suffers from the impairment of abstract reasoning abilities. As such, the tests (consisting of tasks for copying figures, reproducing coloured designs on a card, sorting objects into different groups, and sorting coloured shapes) may not reveal problems that the aphasiologist needs to understand in designing a therapeutic program for an aphasic patient.

The Halstead-Wepman Aphasia Screening Test (Halstead and Wepman, 1949) was designed to provide a rapid, self-contained evaluation of aphasic language behavior. The original form of the Aphasia Screening Test has 51 items which cover all the elements of aphasic disabilities as well

as the most commonly associated communication problems. Errors are coded into a diagnostic profile intended to provide a description of the pattern of the patients language disabilities. The above test also aids in discriminating between patients with left and right hemisphere lesions, for many of the former can copy the designs but cannot write, while the latter have no trouble in writing but many cannot reproduce the designs.

In a different approach, Taylor (1953) developed a scale called the Functional Communication Profile which attempts to measure the functional dimensions of language performance not accounted for in the clinical testing. It consists of 50 integrated communication behaviors considered commom language functions of everyday life. Such items as handling money, indicating a floor to an elevator operator and saying greetings are included. The profile makes no reference to symptomatology or diagnostic labels and thus partly avoids the confusion and ambiguity which exists in the literature on aphasia. Ratings of each behavior are made on a continuum along an eight-point scale on the basis of informal interaction with the patient in a conversational situation. In this natural context the examiner rates what functional use the patient makes of his residual language in five different modalities: movement, speaking, understanding, reading and a miscellaneous category which includes writing and calculation.

The ratings take into account speed, accuracy, consistency, voluntary control without benefit of external cues and compensatory function for the behavior. Each rating is assigned a weighted score which is converted into percentages in each of the five modalities. There is also a provision made for an overall score which is a reflection of the sum of all the scores. It can be used as a single measure of an individual's communicative effectiveness in everyday life. Thus the profile mainly relates to function. The Functional Communication Profile (Sarno, 1969) focusses on the way a patient uses his residual communication skills by giving a quantitative result. Hence it is a rating scale and not a test of language performance.

Eisenson's Examination for Apahsia (Eisenson, 1954) was a tool that used the Weisenburg and McBride classification system and evaluated patients along predominantly receptive or predominantly expressive lines. Originally Eisenson's inventory was devised as a clinical tool to provide the examiner with a good judgement for assessing the variety of language disturbances related to language functions (agnosis and apraxias) which are considered to be common features of aphasic patients. The various test items, some of which are taken directly or adapted from standardized educational tests, are selected to reveal both the assets and liabilities of the patient at the time of testing. Much of the testing material is graded, so that a level of ability within a given area of language function can be estimated.

Although, most of the items are scored on a pass-fail basis, in terms of the actual examination of the stimulus material the clinician is advised to consider any correct or near-correct responses offered by the patient. Since the Eisenson Manual is quite subjective in its scoring, the examination has not been a very popular tool.

The Language Modality Test for Aphasia (Wepman and Jones, 1961) was constructed to sample selected stimulus-response relationships at a uniform level of difficulty. As Schuell (1961) suggests, "such a battery should be most sensitive to covariations of different kinds of tests, but, on the other hand, places limitations on the kinds of tests used, the population studied, or both, in order to maintain a specified difficulty level (p. 296)." Wepman and Jones view their test as an instrument to provide a 'psycholinguistic analysis for an aphasic's language production'.

The theoretical basis upon which this test rests, making distinctions between aphasia as an integrative disorder and the modality-linked transmission disorders of agnosia and apraxia, has been developed by the authors by experimental means, primarily in their factorial studies[7]. Hence the authors claim that "the test provides opportunities for sampling a wide variety of language processes." The test is divided into two main sections: a

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[7]A mention of these factorial studies is made under the section dealing with validation studies.

screening section and the standardized section. Auditory and visual stimuli of pictures, numbers, words, and sentences are presented and oral, graphic and matching responses are recorded according to the classification schema developed by the authors. Wepman and Jones (1961) mention that five statistically derived factors defined the test modalities: (1) oral response to visually presented stimuli; (2) oral response to orally presented stimuli; (3) written response to orally presented stimuli; (4) written response to visually presented stimuli; and (5) matching of auditory or visual stimuli to picture alternatives.

With this, the authors say of their test:

> The LMTA provides standard visual and auditory stimuli and seeks responses in speech and writing; it tests comprehension of language symbols as well as the ability to imitate them along both common input modalities; it deals briefly with form recognition, arithmetic ability, spelling and articulation. It provides separate information about the adequacy of symbolic and non-symbolic language behavior. Through a study of the patient's spontaneous story-telling, it provides a measure of his ability to use syntax as well as vocabulary. The test is easy to administer, and is interesting to the patient. From its results, the best approaches to therapy are easily determined. Because of its standardization it provides a research tool for both intra-individual changes and inter-individual comparisons (1961, p.2)

Despite the above considerations, the LMTA suffers from many drawbacks (Rigrodsky, 1972). The materials used in the LMTA do not cover a wide range of linguistic abilities; for example, there is little testing of auditory comprehension, as evidenced by the subject's designation of a variety of objects named by an examiner or by following

vocally-administered instructions. Further, the range of difficulty of items is insufficient to detect minimal language defects. As Rigrodsky (1972, p. 1346) mentions:

> However effective the LMTA may be in measuring aphasic symptomatology no test can hope to sample all the components of the complex behaviors which result from brain injury. In utilizing the test an examiner should be aware that he is only measuring a specific type of verbal behavior and that the structural and semantic responses obtained relate specificially to the communicative requirements of the test; and hence additional samples of language, obtained as the result of other communicative or functional situations are also needed and should be added and compared to the results obtained from the LMTA.

The test also is 'final-product oriented': that is, evaluations are generally made of the verbal decision selected by the examinee and nothing is known of the strategies he employes in making the final decisions. Although the test gives some indication of prognosis relating to symptom analysis, there is no opportunity in the LMTA to appreciate the learning potential of the individual associated with specific areas of difficulty as the test does not elicit any gestural responses (Rigrodsky, 1972).

The Token Test (De Renzi & Vignolo, 1962) is a test of auditory comprehension. It aims to assess purely linguistic parameters, by making use of coloured shapes. Here, the criterion in using four coloured forms is to reduce the amount of redundancy in commands given, in the nature of the objects presented, and in the situation in which they are presented (Noll & Berry, 1969). The first part of the test uses simple instructions and is considered to be sensitive

in nature as it demands that the patient understands the meaning of each word independent of any aid from contexts or preceding verbal material. The later part of the test incorporates different parts of speech, viz, prepositions, conjunctions, and adverbs into the verbal commands which vary in difficulty. As these verbal commands are devoid of natural context the patient is faced with an artificial situation while taking the test. Under such unnatural situations, the minor receptive disturbances may not become as evident as claimed by the test.

There have been many commments made with regard to the instructions used in the Token Test. Whitaker and Noll (1972) and Lesser (1976) comment that in some communities, some normal adults may interpret the word 'touch' in the Token Test in a way which would give them an error on conventional marking but which is a logical and apparently consistent interpretation: for a sentence such as 'touch the blue square and the yellow circle' some patients may respond in the same way as they did for 'touch the blue square with the yellow circle.' This small issue points up the more general problem of dialect differences in aphasia assessment.

The Orzeck Aphasia Evaluation (Orzeck, 1964), as a screening test, surveys a range of verbal and visuomotor behaviors characteristic of that measured by other aphasia screening tests. As such, OAE as a language assessment device does not emphasize objective scoring and

quantification (Reitan, 1972). The test items deal with spontaneous speech, object naming, word and sentence repetition, writing, copying of geometric figures, arithmetic operations, oral reading, finger recognition, right-left orientation and sensory suppression. The OAE can be considered as only an approach to screening for gross language deficits. However, as Meirer (1972) mentions, the OAE is not supported by research to justify its routine application in clinical settings as suggested in the manual. Another major shortcoming is the overinclusive use of the concept of apraxia and agnosia and the absence of descriptive criteria for evaluating language impairments. In summary, 'the Orzeck Aphasia Evaluation includes examining procedures that apparently have been derived from several sources and compiled into a single procedure.'

The Minnesota test (Schuell, 1965), on the other hand, is a research tool, based on Schuell's unidimensional approach to language, to study the breakdown of language as comprehensively as possible. It is a long inventory with a battery of 47 tests that can be used to provide an overall picture of the level of functioning of the aphasic and a system for classifying aphasic types. Here the major areas of assessment include (1) auditory disturbances (items ranging from word recognition and discrimination to sentence and paragraph comprehension), (2) visual and reading disturbances (items range from matching of forms to reading of sentences), (3) speech and language disturbances (items

include testing for articulatory movement, naming, word defining, picture description and paragraph retelling), (4) visuomotor and writing disturbances (items range from copying of forms and letters to writing to dictation and written sentence formulation) and (5) disturbances of numerical relationships and arithmetic processes (items include making change, clock setting, simple numerical combinations, and written problems).

Although the MTDDA is quite well constructed, there are some minor points in test administration and scoring that need to be clarified. As Rigrodsky (1972) suggests, in the test for 'discriminating between paired words,' the type of response which the patient is expected to make is never indicated. Similarly, in the test which requires, 'identifying items named serially,' it is not clear whether an error is scored for the order in which a patient points to each of the items named, or if the response is in error only if he fails to point to each of the serially named items. On the test for following directions, the instructions specify that the patient should 'do what I ask you to do,' but two of the items are not directional but relational (which pencil is longer? which one do you eat with?). The measurement of more complex spontaneous language production (e.g., expressing ideas, describing a picture, writing a paragraph) would be more meaningful.

Schuell argued that aphasia represents a reduction of available language and that this is measured by the

Minnesota test, in terms of its different test tasks. Thus, MTDDA is a standardized tool for the measurement of language disorder resulting from brain damage, and the clinicaian will appreciate the comprehensive nature of the test (measurements based upon a classification model), which permits subject groupings based on the test results. Here the test results will enable the speech therapist to plan the relevant therapeutic guidelines.

The Sklar Aphasia Scale (Sklar, 1966) is developed to 'provide objective measurements and evaluations of speech and language disturbances resulting from brain damage.' It is designed primarily to assess the residual language skills of patients who have acquired aphasia secondary to central nervous system damage. The SAS quantifies language abilities in aphasics into four major language areas: auditory verbal comprehension, reading comprehension, oral expression, and graphic production. Since the Sklar Aphasia Scale does not provide any information regarding the interpretation of specific abnormalities of the verbal behavior, the results of the test rely heavily on the clinician's impressions.

Boone (1972) considers the Sklar Aphasia Scale 'as an attractive test for the busy speech clinician with many aphasic patients.' The SAS identifies relative language levels, offering distinctive profiles of auditory decoding, visual decoding, oral encoding, and graphic encoding abilities for each patient tested. While both severely involved and mildly involved patients can be identified by

clinicians employing the SAS, there are not many test items which discriminate well among patients with moderate language impairment. That is, data suggest that moderately involved patients all seem to come out with similar looking test profiles on the SAS, despite easily observed differences in how they speak; this must be weighed against Boone's claim that 'SAS gives a lot of language information with comparatively simple test administration procedures (1972, p.1362).'

Though the battery follows the conventional lines in assessing the four broad categories of language behavior - viz., speaking, understanding of speech, reading and writing, the test tasks are not graded in difficulty. Overall level of test performance is considered to be a prognostic index by Boone and the generalization is made as follows: 'the lower the total impairment score, the better the prognosis for benefiting from training.' However, no empirical evidence to support this simplistic statement (which fails to take account of either the possibility of changes in the underlying disease process or of qualitative differences in pattern of performance) is presented. In summary, this test battery is inadequately standardized and there is no evidence that it possesses distinctive merits for the evaluation of aphasic disorders.

At present, the Porch Index of Communicative Abilities (Porch, 1967) is one of the most widely used aphasia test batteries. It consists of 18 subtests sampling gestural,

verbal and graphic abilities. For each subtest, the examiner attempts to elicit a specific response from the patient to each of 10 common stimulus objects (cigarette, comb, fork, key, knife, matches, pen, pencil, quarter, and toothbrush) placed before him. Since the 10 objects are not graded in difficulty, the task involved in each subtest can be viewed as an 'experiment' with nine direct replications (Sidman, 1960). The examiner assigns to the patient's response to each of the 180 subject-object combinations a score from one to 16, depending on which of 16 multidimensional scoring categories he feels it falls into. Porch (1967, 1973) claims that the PICA is the one test which many investigators feel fulfills the need for a sensitive, precise and objective test for aphasia.

However, the PICA is criticized by Martin (1977) on several lines. Commenting on the multidimensional scoring system (the system designed to specify sensitively the nature and degree of communicative disability in terms of several dimensions) as a binary choice, Martin says that this type of scaling does not specify the nature as well as details of the response.

> For example, with the scoring system used in the PICA, a patient, when asked to name a pen, might give no response at first, necessitating a repeat of instructions (9); describe the object (5); necessiating additional information or a cue (8); then give, in a distorted manner (14), the related response 'ink' (7); and finally change the response (12). The final score, however would be (8) because the patient has required a cue. In other words, although the patient has given you behaviors listed in the multidimensional scale from 14 down to 5,

> only one score and therefore only one aspect of the response is reported. (1977, p. 548).

Martin has also questioned the validity of the PICA as an index of communication. Rather than testing or indicating level of communication, effectiveness of communication is often ignored in the PICA. For example, under scoring noted in the manual for test 1, verbal, the following comment is made: 'score only verbal responses, ignore all gestural and graphic responses.' The tester watches the patient only to determine if he is doing the task and to see which object the patient is talking about. To this, Martin comments that if one is concerned with the nature of the response or the effectiveness of communication, scoring only the verbal output when gesture is present eliminates much important information. 'Gesture when combined with defective verbal output is constant in communication (Martin, 1977).' Of course, the nonverbal communication is tested in tests 2 and 3 of the PICA battery. The instructions for the tests 1 and 2 are often confusing to the patient. In the PICA, a sense of supportiveness by the therapist is limited by the rigid administrative procedure. There is no place for demonstration, reassurance and rephrasing - all tools that a clinician will use to discover if the capacity for that behavior exists. The only comments that the examiner can make are the repeats and cues as given by the manual. For Martin, this is a behavior that in itself can be interepreted by the examinee and can act as either a negative or a positive agent. Unexplained failure,

especially in the earlier tests, can affect later performance, as has been demonstrated to an extent by Brookshire (1972) in his investigations of the effects of task difficulty on naming performance by apahsics.

Martin further suggests that the PICA suffers from inadequacies of response categories. The category of 'incomplete responses' is not clearly explained. A fundamental conceptual difficulty with the PICA lies in the lack of clear definitions involved in the theoretical construct for the test. 'Language and communication' and 'aphasia and communication dysfunction' are used synonymously. Boone (1972) states that:

> A major criticism of the PICA would have to be its relative lack of direct testing of auditory verbal materials which are only tangentially tested. There is no way in using the PICA to determine where auditory verbal abilities breakdown to such parameters as length of instruction, complexity of linguistic instruction, auditory verbal memory length, auditory sequencing complexity, etc., (p. 1354-1355).

With regard to scoring, Silverman (1974) comments that there appears to be a psychometric problem with the PICA scoring system in that the mean of the patient's scores on a PICA subtest may not describe his most frequent response to the items in that subtest. In fact, it may designate a type of response with respect to the five dimensions used to define scoring categories that did not occur even once. As such, Silverman suggests the use of 'mode score as a summary measure of patient's scores on subtests (1974, p.225).' The mode score for a subtest would describe a patient's most

frequent, and hence representative response to the 10 items in the subtest. Since the PICA scoring system apparently only has been demonstrated to have ordinal properties, the mean measures, meant for interval or ratio properties, can not be applied.

Boone (1972) asserts that the 'Porch system of graded scoring permits the examiner to determine gradations of response for the various modalities of input and output (p. 1354).' However, the learning of the 16-category system is difficult for the clinician, and the complexity of this 16-category system makes the question of test reliability critical for general utilization of the PICA.

> The PICA's weakness appears to be the length of time required for testing and its focus on the visual and graphic abilities of the patient with emphasis on the vital aural-oral areas. (Boone, 1972; p. 1355).

The Neurosensory Center Comprehensive Examination for Aphasia (Spreen & Benton, 1969) is a test of performance. It was designed by its authors to produce a quantitative profile of specific deficits associated with brain damage. Benton and Spreen incorporate in their testing procedure control tasks which determine whether failure is due to sensory-perceptual defects. They also use non-linguistic criteria in tasks such as tactile-visual matching.

A distinctive feature of the NCCEA is the provision for constructing a profile of directly comparable percentile scores, corrected for age and educational level, for any patient. These profile sheets, based on adult measures 'both

normative and aphasic' are used in the clinical assessment procedures. Through the uniform application of a standard examination Benton (1967) hopes that aphasiologists may establish an operational understanding for scientific communication in the field of aphasia. Specific aims for the International Battery, as noted by Benton include: (1) the development of standards for an examination that will assess quantitative and qualitative aspects of disorders, and (2) profiles of language performance that can be related to the nature of involvement, prognosis, and clinical procedures. In the final form, Spreen and Benton hope that the 'International Test for Aphasia' will be reduced to no more than ten subtests that may be administered in an examination period not to exceed 50 minutes. However, their test does not cover all the aspects of language testing, viz., testing for general knowledge and situational variables. With the non-availability of the standardization data the NCCEA lacks validity in clinical situations.

The Boston Diagnostic Aphasia Test (Goodglass & Kaplan, 1972) was developed in the tradition of approaching the aphasia examination on the one hand as a psychological analysis and measurement of language related skills and on the other hand as a problem in relating particular configurations of symptoms to their neuropathological correlates. Accordingly, the purpose of aphasia testing was geared to meet the following aims: (1) diagnosis of presence and type of aphasic syndrome, leading to inferences

concerning cerebral localization, (2) measurement of the level of performance over a wide range, for both initial determination and detection of change over time and (3) comprehensive assessment of the assets and liabilities of the patient in all language areas as a guide to therapy.

The Boston Test mainly consists of tasks relating to (1) conversational and expository speech (analysis of the tape recorded answers to the pictures presented to the client), (2) auditory comprehension (word discrimination, body-part identification, commands, and complex ideational material in which a paragraph is read and the patient questioned on it), (3) oral expression (repetition of mouth movements, verbal or oral agility, recitation, singing and rhythm, repetition of words, repetition of phrases, responsive naming, visual confrontation naming, body-part naming, animal naming and oral sentence reading), (4) understanding written language (symbol and word discrimination and phonetic association), and (5) writing (mechanics of writing, recall of written symbols, written-word finding, written confrontation naming and written formulations).

In the Boston testing procedure, rating scales are used which give some idea of the degree of impairment rather than only positive or negative scores. It is subjective but more appropriate than considering success or failure. As Goodglass and Kaplan point out,

> the limitations of this test are that the materials and procedures provided by the test merely serve as convenient aids for sampling relevant performances of the patient. The scores do not objectively and automatically classify the patient nor point to the optimum approach to therapy (1972, p. 2).

The test is mainly neurologically oriented, and presumes that components of language are assessed in isolated forms (Lesser, 1978). However, it is impossible to reach this ideal completely since one can test an expressive function only by choosing some instrumental input channel through which to elicit the expressive behavior. In the same way, one can test receptive functions only by designating an instrumental response modality through which the subject demonstrates his comprehension. The heavy reliance on neurological data makes the test less linguistically favourable.

The Queensland University Aphasia Test (Q.U.A.T) was designed by Jordan and Tyrer (1972) as an objective instrument to evaluate, and measure reliably and progressively, the linguistic defect in adult aphasia initially and following therapeutic programs. In its present form the battery of language tests in the Q.U.A.T is comprised of four groups corresponding to the four major channels of verbal communication, viz., auditory comprehension, oral expression, reading and writing. Through the use of its 30 sub-items, the Q.U.A.T provides for systematic testing of all possible combinations of the channels of communication taken in pairs of one afferent and one efferent modality. Two shortcomings of the test are (1)

that it takes a long time for administration, and (2) non-availability of standardization data makes it less useful in practical terms than it might otherwise be.

2.1.2 The recent tests

The Western Aphasia Battery (WAB) was developed by Kertesz and Poole (1974) to assess seven areas of functioning with aphasic patients. Here, the seven areas include spontaneous speech, auditory comprehension, repetition, naming, reading and writing, praxis and construction. The spontaneous speech subtest rates both fluency and information content of the subjects speech in question-answer and picture description contexts. The auditory comprehension subtest assesses understanding of yes-no questions, identification of objects, and pictures in 10 categories, and execution of commands increasing in complexity. Repetition of words, phrases, and sentences comprise the repetition subtest. Naming is assessed using tasks of object naming, word fluency, sentence completion, and responsive speech.

Since each subtest contains a different number of test items resulting in different scores, an overall resultant score called the Aphasia Quotient (AQ) is calculated and it is considered as a functional measure of the severity of spoken language deficit in aphasia. The subtests of reading and writing evaluate reading and writing skills. The WAB's classsification types relate to global, Broca's, etc., all

examples of the conventional classification system. The test appears to be lengthy in administration and the results relating to the conventional classification system by location of lesion do not necessarily provide the therapist with useful information about the patient's linguistic behavior.

The Aphasia Language Performance Scales (Keenan and Brassel, 1975) was developed as a devise to overcome the problems faced with the traditional tests, namely, time consumption and scoring. This test is composed of four scales (listening, talking, reading, writing), each containing ten items. The items on each scale are graded in difficulty and range in linguistic complexity. The four scales are thought to be independent of one another, i.e., performance on test items of one scale is not affected by deficits tested on items from another scale.

The test allows for varied response types, viz., correct or self corrected response, correct response following a prompt and an incorrect response. The scales provide for an visual view of the performance illustrating the patients pattern of impairment, severity of the deficit in each modality, and rate of improvement. The performance scales' reliability coefficient is being determined (Keenan and Brassel, 1975). However, the non-accountability of gestural responses makes the test less favourable from a communicative view point.

The Revised Token Test (RTT) developed by McNeil and Prescott (1978) is similar to, but not identical with, the original De Renzi and Vignolo Token Test. The RTT represents a combination of views on how to approach auditory deficits associated with brain damage. Although not based primarily on linguistic concepts, the RTT is based on the elementary concept of stimulus/response sequences. In other words, a specific command can be expected to elicit a specific sequence of responses with a normal population with a deviation in any of many dimensions representing an abnormality. The RTT is also based on the modality concept. That is, it is designed to isolate and assess the auditory input modality and the visual input modality for interaction with the stimuli. Thirdly, the test is based on Wernicke's (1908) concept that there are different primary types of aphasia, or at least that the auditory modality can be affected in a different degree than other input or output channels. A fourth view represented by RTT is an attempt to assess the deficit associated with specific parts of speech and different types of sentence structure (but not unusual syntactic forms). Using a fifth concept of 'cortical efficiency' in the behaviors scored, RTT is supposed to indicate the general hierarchy of linguistic structures that are disturbed as a result of brain damage.

As Noll (1979) suggests, the unique feature of the Revised Token Test is the scoring system. Rather than a right/wrong scoring, the test uses a 15-point

multidimensional scale, not unlike that employed by Porch (1967) in his Porch Index of Communicative Abilities. Noll further points to some problems with scoring conventions by giving the following examples: The command 'touch the big red square and the big white circle' contains eight constituent elements: touch, big, red, square, touch (implied), big, white, and circle. Here, the clinician has to consider eight scores as the subject does this one command. One scoring convention in the RTT is that no unit in an individual command can receive a score higher than the verb preceding it. The first score to be entered on the score sheet is the reponse to the verb (*touch* or *put*). In most cases, all units following the verb, e.g., size, colour, shape, should be scored the same as or lower than the verb. 'Therefore, as a short-cut in scoring, the only values which need to be written in the score sheet are those units which received a lower scale number than the verb.'

Although this scoring rule makes it easier to handle the mechanics of administering the test, one might question the soundness of such a rule (Noll, 1979). For example, in the command 'touch the big blue circle,' if the patient *points* rather than touches, the instructions are that the verb is scored 7 (error), as it was the wrong action. But if the patient points to the big blue circle, the scoring rule states that the size (big), colour (blue), and shape (circle) units of the command must also be scored 7, even though they were correct, because the units following the

verb score the same as or lower than the verb. This rule seems to contradict the basic tenet of the RTT, viz., that every element of the command is assessed and receives a separate score.

The authors state in the manual 'that items believed to be unusual in their linguistic structure have not been included in the RTT.' However, for Noll, some commands of subtests IX and X seem to be ambiguous for normal subjects. The test also faces the problem of scoring the test responses precisely. For example, how does one interpret the command 'unless you have touched the white square, touch the green circle' or 'if you have not touched the white circle touch the blue square.' Here the subject may report that he touched the white square and the white circle in one of the previous subtests. As Noll suggests, the Revised Token Test includes complex syntactic forms in some commands which appear to be quite difficult to interpret for one reason or another.

The Communicative Abilties in Daily Living (CADL) was developed by Holland (1980) to assess the communicative or functional abilities of aphasic patients. The CADL is a 68-item test that deviates from traditional formal testing through the recreation of a series of everyday situations to which the patient may respond through any language modality. The only criterion for judgement of a response as adequate is its ability to get the point across. Thus, conversation, problem solving, abstraction, reading, writing, telephone

skills and other abilities are examined in role-playing situations and through the interpretation of drawings, photographs and tables employing a three-point scoring system.

The total test score is simply the cumulative sum of the item scores that could be compared with the performance of the aphasic and non-aphasic adults of the same age, sex, and living situation. The test gives profiles of the subject's testing based on their individual 68-item score. However, the test does not illustrate the efficacy of various response modalities. It is not primarily a language test but can be used as an useful supplementary test. As Mercer (1981) suggests:

> All patients' responses must be described verbatim during administration of the test. This may cause pacing to become slower, inhibiting the natural conversational style intended by the test authors. The three point scoring system may not be adequately sensitive to measure qualititive performance changes over time. Moreover, neither implications for therapy emphasis nor predictions for improvement are easily obtainable. The CADL generally does not challenge high level aphasic clients (p. 388, 1981).

2.1.3 Conclusions

As evidenced above, the standardized testing in aphasia does not permit the placement of a patient into one formal category (Lesser, 1978). Schuell's classification, based on her tests makes a practical distinction of aphasia with or without different accompanying modality deficits. Wepman & Jones' battery requires categorical scoring judgements from

the examiner about the nature of the responses so that patient can only be grouped as syntactic, semantic, pragmatic, etc. The Functional Communication Profile and the Communicative Abilities in Daily Living mainly evaluate the functional communicative abilities of aphasic patients. The Token Test and the Revised Token Test only assess the receptive abilities of the patients. The Boston Diagnostic Aphasia Test makes the placement of patients into one of the diagnostic categories based on the test results, the subjective ratings of his spontaneous speech and his score on the subtests of the auditory comprehension.

It appears that many of the current standardized testing procedures used to assess aphasic speech are not linguistically oriented.

> The areas of prognosis and treatment in aphasia have suffered setbacks because of lack of reliable diagnostic tools. Theraputic techniques today tend to be general in nature and are based on the assumption that aphasics present a similar linguistic syndrome (Toubbeh, 1969, p. 57).

Many of the standardized tests lack extended discussion of the rationale for their development and standardization. As might be assumed, testing in aphasia reflects the diverse theories that exist on language behavior and aphasia. The methods of evaluation in use appear to give too much consideration to the disruption of specific modalities of input or output or to the relationships between the two; this may provide inadequate information on either the language loss or the language retained by the aphasic

patient. Bearing in mind the criticisms leveled at existing tests for aphasia, some considerations in the construction and validation of tests are discussed in the next Chapter.

3. EXPERIMENTAL REVIEW

This Chapter deals with the experimental studies on testing in the areas of test construction, type of test tasks and clinical validation of tests.

3.1 General considerations of test construction, type of test tasks and validation studies

3.1.1 Test construction

There are two basic psychometric problems inherent in the design, construction and standardization of the existing aphasia tests. The first is a problem of a conceptual nature, the second is a problem of a more technical nature (Benton, 1967).

3.1.1.1 Conceptual problem

According to Benton, the conceptual problem in aphasia testing refers to how one views the disturbances that are labelled as aphasic symptoms, and therefore decides what a test will assess. For example, a definition of aphasia as a purely linguistic disorder would require dramatically different evaluative procedures than if aphasia were defined in terms of stimulus/response sequences, complexity of propositions, levels of abstraction, or input and output

modalities (Benton, 1967). Likewise, the purpose or purposes for testing may require decidedly different psychometric procedures and techniques. If the purpose of a test is to find commonalities or to group or classify (e.g., Broca versus Wernicke) patients, the design may well differ from a test whose function is to sample a range of behaviors for purposes of basing treatment. Different people think in different ways about language, and in each case, the fundamental preconception will determine the nature of the aphasia examination and of the specific tasks included in it. Benton further suggests that given the diversity of conceptual approaches to the problem of the aphasias, construction of a linguistically based test has been very difficult with the lack of a theoretical language model.

Tests have been developed primarily on pragmatic grounds. Here, there has been considerable disgreement about the selection of items in each test, depending upon how the author defines the aphasic deficit. For example, the LMTA is based on the modality-linked psycholinguistic model of language which Wepman and Jones (1961) have proposed. The tasks in the LMTA relate to object identification, sentence repetition, object naming, story-telling etc. This is in contrast with the non-linguistic testing approach taken up by McNeil and Prescott (1978) who include concrete forms and consider non-verbal responses in comprehension testing. Consequently, the status of tests of repetition of digits, words or sentences might well be controversial, valued by

some but considered by others to be essentially irrelevant to the problem of aphasia.

3.1.1.2 Technical problem

Cronbach (1972) and others suggest that there are general psychometric recommendations for any formal test. Some of the more essential factors to be considered include a highly standardized administration, four basic types of validity (content, construct, concurrent and predictive) and at least three types of reliability (test-retest, split-off and alternate form). McNeil and Prescott (1978) add some more specific psychometric considerations, including: (1) homogeneity of stimuli across all subtests and homogeneous subtest items or questions within subtests, as given by Porch (1971); (2) a range of subtest difficulty as discussed by Osgood and Miron (1963); (3) the necessity of a relatively large number of subtest items, as described by McNeil and Prescott (1973); (4) the transformation of scores into usable comparative norms or ranks, as discussed by Benton (1967); and (5) the selection of an appropriate method of noting subject performance, such as the multidimensional system described by Porch(1971).

Illustrating the technical problems, Benton (1967) mentions that the construction of a technically adequate test battery to evaluate the status of language function involves a number of tedious, time consuming tasks, viz., (1) careful selection of items for each test in the battery;

(2) pilot testing to determine reliability, validity and level of difficulty; (3) collection of normative data for performance on each test by appropriate groups of subjects, including the assessment of the influence of such factors as age, sex, and cultural status on performance level; (4) determining the effects of practice or prior experience with the tests; (5) considering whether two or more equivalent forms of the battery should be constructed in order to permit unbiased repeated examination of the patient; (6) correcting scores for the influence of age and educational level; (7) transforming raw scores into standard scores or ranks so that one obtains a valid picture of an individual's strengths and weaknesses and, finally, (8) standardizing the battery separately for each language community in which it is to be given since the same item does not necessarily have the same meaning or difficulty level in every community: the difficulty of a specific test of language understanding will be determined by factors peculiar to each language, such as the relative frequency in each language of the words in the proposition presented to the patient, the relative ease or difficulty of pronouncing the words in each language and the grammatical form in which a proposition is stated.

In listing the above criteria, Benton (1967) says:

> Standardization is necesary so that results can be compared, on an objective basis, between clinics. Assessing the language of an individual involves assessing an idiolect. It would be more beneficial to have a battery of procedures aimed at investigating different aspects of language rather than a battery of standardized tests. The clinical

> utility of such a battery could then be considered. Linguistic appreciation of observed difficulties in all modalities of performance would have to be accounted for. It is the interpretation of observed language disturbances that is critical. Certain procedures used in the test batteries are relevant to linguistic assessments if interpreted in a satisfactory manner (p. 138).

McNeil and Prescott (1978) mention that the lack of a standardized administration of any test contains several inherent weaknesses. They include: (1) the limitation of test-retest, intra and inter-judge reliabilities, (2) the inability to acquire valid normative data, and (3) the reduction of chances for the clinically significant patterns of behaviors to arise. Some tests presently in use that do not meet the above requirements are: Eisenson Exmination for Aphasia (1954), Token Test (1962), Functional Communication Profile (1969), and Boston Diagnostic Aphasia Test (1972). Other criteria lacking in the currently available tests include: item type difficulty[8] (Head's Test, Eisenson Examination for Aphasia and the MTDDA); range of subtest difficulty (Language Modalities Test for Aphasia, Eisenson Examination for Aphasia, Sklar Aphasia Scale and Porch Index for Communicative Abilities); homogeneity of subtest items (only accounted for in Porch's test), and adequate number of subtest items (Eisenson Examination for Aphasia, LMTA, MTDDA, Functional Communication Profile and Boston Diagnostic Aphasia Test).

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[8]This refers to the range of easy and difficult items of the test tasks.

An adequate description of subjects' performance is cited as an important criterion in standardization (McNeil & Prescott, 1978). Many test constructors have supplemented plus-minus scoring with descriptive notes, as suggested by Schuell (1965) and Emerick (1971). The LMTA employs the plus-minus criteria for its auditory section, which is rather unsatisfactory because they employ rating scales for other subtests. Jordon and Tyrer (1971) contains a full discussion of the adequate description of subjects' performance for test construction in the field of aphasiology, but which are lacking in some of the present standardized tests. Porch (1971) discusses the necessity of reporting not only a correct or incorrect response, or even severity of the error, but also the type of subject error. The above mentioned technical problems have been overcome to some extent by several research workers working on individual tests. This is given in the section dealing with validation studies.

3.1.2 Type of test tasks

Several investigators (Schuell, 1963; Wepman & Jones, 1961; Porch, 1971; Brookshire, 1974) have stressed the fact that an adequate diagnostic test must sample relevant kinds of behavior in all language modalities over the entire range of aphasic deficit. The aphasia test batteries generally include a wide range of tasks so that the nature and severity of the language problem and associated deficits may

be determined. Because aphasia tests concern disordered language functions in themselves and not their intellectual ramifications, test items typically present very simple and concrete tasks which most children in the lower grades can pass (Brookshire, 1974). The common aphasia test questions, for example, MTDDA, LMTA, OAE, ask the patient (1) to name simple objects; (2) to recognize simple spoken words; (3) to recognize and repeat simple printed letters, numbers, words; (4) to do primary level arithmetic problems; (5) to give verbal and gestural answers to simple printed questions; and (6) to point to or write letters, words, numbers, etc.

In the standardized tests, most of the expressive tasks used to examine aphasics are only suitable to elicit the production of one word, or at most, of a series of unconnected words (Brookshire, 1978). The patient is required to name a visually presented object, to answer a question verbally, to repeat the words or sentences, to give as many words as he can belonging to a given category, to recite memorized sequences, etc. For De Renzi and Ferrari (1978), these tasks are easy to administer, easy to score, and sensitive to the symptoms of expressive aphasia, but they are not suited to assess the extent to which the patient is able to verbalize his ideas. 'The reason why this ability is not evaluated is that it is difficult to devise tasks eliciting free production of sentences and at the same time meeting the requirements of a formal test, namely to predetermine as far as possible the response the patient is

expected to make (De Renzi & Ferrari, 1978).'

However, the fact that the ability to speak in unconnected sequences of words provides the critical dimension for assessing the patient's communication level, would urge the introduction in every aphasia battery a procedure for making this evaluation. For De Renzi & Ferrari (1978) 'a common device to get expository speech is to engage the patient in open-ended conversation or in free-narrative, but this procedure leaves the examiner without a precise standard of reference to which to compare the patient's verbal behavior (p. 280).' Goodglass and Kaplan (1972) and Gleason et al. (1980) have tried to overcome this weakness by presenting the patient with a picture story with instructions to tell all about what is happening in the picture. In this regard, De Renzi & Ferrari (1978) suggest that although this procedure may be effective in getting the patient to produce connected sequences of words, its scoring remains difficult because the subject is still free to choose how to verbalize his thoughts. Though such tasks are difficult to score, but they offer a good sample for analyzing a patient's functional language.

In general, the production tasks in all the standardized aphasia tests assess relatively pure aspects of structured performance, for example, the production of nouns and repetition of sentences. As Kertesz and Phipps (1977) mention, fluency, repetition, naming and information content of speech have thus become standard items in production

tasks by virtue of their importance in describing language impairment.

Comprehension tasks attempt to evaluate the comprehension process by presenting stimulus materials to a subject, and on the basis of his or her response, making an inference as to the extent of the subject's ability to comprehend (Boller et al., 1977). Although little research has been done in the response of persons with impaired comprehension to changes in syntax, several tests include test items in which the sentence structure is modified, to evaluate the subject's ability to comprehend the essential message across various changes. Most test material is verbal in nature, although nonverbal tasks as in PICA are often used to establish a subject's ability to understand the test materials to complete the tests of comprehension.

Thus most batteries, for example, MTDDA, LMTA, OAE and the Token Test include some measures of sensory processing, motor skills, and praxis, as a preliminary aspect of the evaluation of comprehension. It is important to note, however, that many tasks that appear to be nonverbal may require some primary level of language comprehension, making difficult the form of assessment of sensory processing and motor skills. As Boller et al. mention, in many tests of comprehension in standard aphasia batteries, identical or similar tasks are employed. Most of these tasks are variations of the following: matching spoken or written words with their significates either in the form of objects

or pictures selected from an array; matching spoken phonemes, letter words or phrases with their letter equivalents; answering spoken or written questions, yes-no or more extended responses; following spoken or written directions by carrying out a single action or a series of actions; and completion of written or spoken sentences from which one or more words have been omitted.

Conventional tests for auditory comprehension have involved the following types of tasks (Brookshire, 1978): (1) pointing to objects named by the examiner; (2) answering yes-no questions; (3) following directions (commands); (4) identification of body parts; (5) object manipulation; (6) identification of tokens; (7) paragraph answering or retelling through nonverbal responses; (8) discriminating paired words (bees/peas); (9) pointing to letters shown by the examiner and (10) identifying common sounds; (11) digit repetition; (12) sentence repetition; and (13) repetition of single and series objects. Analysis of the above tasks reveals certain parameters inherent in them (Brookshire, 1978). They are: (1) perceptual abilities, (2) retention span, (3) word meaning, (4) sentence meaning and (5) general knowledge. However, these tasks do not relate to the 'hearer's knowledge of the world (Brookshire & Nicholas, 1980).' Normal individuals use extra-linguistic information, viz., intonation, stress and gestures, in comprehension processing, and this information is not made available in these tasks. Situational probability, listening activities,

and redundancies all add to the normal comprehension process. As such, the test results may not correlate with what the aphasic patient is able to do in real life. The routine tasks fail to measure the total comprehension and the daily life complexity level (Brookshire & Nicholas, 1980). The measurement level is always below the daily life complexity level. Consequently, the test results tend to be less than optimally directive in therapeutic approaches and prognostic indications.

Porch (1971) believes that tasks must be selected which sample a wide range of communicative skills at various levels of difficulty and be interpretable in the light of different theoretical hypotheses. In summary, it appears that the tasks selected to be included in a standardized test battery vary somewhat from investigator to investigator depending on the theoretical framework within which each is operating and the findings he is seeking.

3.1.3 Validation studies

Validation studies provide normative data of a test in order to encourage its employment as a clinical device. The test's effectiveness and high discrimination power in distinguishing between normals and clinical groups are shown by investigating factors that could possibly influence the validity. Validation studies also report data on standardization and variables involved in the study. As such, they stimulate the technical development through a

systematic and comprehensive investigation of the aspect of aphasic impairment. Besides dealing with validity, validation studies deal with altering the parameters of the test in a systematic manner, and such data provide the clinician with a good guideline in planning therapy. The research studies discusssed in this section emphasize the validation aspect of currently available standardized tests. They also point to inadequacies noted in the clinical application of these tests.

The Language Modalities Test for Aphasia was used by Wepman and Jones in a series of subsequent research studies, after its development as a clinical instrument. Jones and Wepman (1961) performed a factor analysis of the scores obtained with the LMTA on 168 aphasic subjects. In their study the authors subjected the scores of the test to a varimax factor solution. Six significant factors were found and four out of those appeared to represent input-output transmission functions, as defined in Jones and Wepman model. The factors were: Factor A, visual to oral transmission; Factor B, aural to oral transmission; Factor C, visual to graphic transmission; Factor D, aural to graphic transmission; Factor E, ability to comprehend language symbols; and Factor F, ability to perform simple arithmetic operations. With these results Wepman and Jones (1961) demonstrated the existence of several dimensions that underlie test performance of aphasic patients, thus arguing against the hypothesis that language disturbance after brain

damage may be viewed as a unitary general disorder.

Schuell, Jenkins and Carroll (1962) performed a factor analysis of the scores obtained with the Minnesota Test for the Differential Diagnosis of Aphasia from 157 aphasic subjects. There were 69 tests comprised of 679 items, including tests for auditory comprehension, visual and reading performances, visuo-motor and writing performances, arithmetic processes and body image. Tetrachoric correlations[9] were used as a basis for determining the principal components. The analysis presented five important factors: Factor 1, language behavior; Factor 2, visual discrimination; Factor 3, visuospatial behavior; Factor 4, gross movements of speech musculature; and Factor 5, recognition of stimulus equivalence. These findings, according to the authors, confirm the hypothesis that along with the general dimension of language impairment additional variables may play a role in aphasic behavior, and must be taken into account in the evaluation and treatment of aphasic conditions as well as in the formulations of conceptual models of aphasia.

Since its introduction in 1962, De Renzi and Vignolo's Token Test has been studied extensively (Boller et al. 1977). Some clinicians and researchers have investigated its clinical validity (Orgass & Poeck, 1966; Swisher & Sarno, 1969; Van Dongen & Van Harskamp, 1972), its linguistic

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[9]A statistical test for expressing relationships between pairs of variables (Cohen & Cohen, 1975).

properties (Whitaker & Noll, 1972; Lesser, 1974), and its usefulness with children (Noll, 1970; Noll & Lass, 1972; Hahn & Weiss, 1973). Because of its clinical value to aphasiologists and speech clinicians, the Token Test has undergone numerous modifications since its original development, including changes in the test tokens (Noll & Berry, 1969; Spreen & Benton, 1969; Noll, 1970), the wording of the commands (Boller & Vignolo, 1966; Orgass & Poeck, 1966; Noll & Berry, 1969; Noll, 1970), the composition of the tokens and the scoring system (Boller & Vignolo, 1966; Orgass & Poeck, 1966; Berry, 1973; Hahn & Weiss, 1973; McNeil & Prescott, 1978) and the number of test items (Boller & Vignolo, 1966; Spellacy & Spreen, 1969; Hahn & Weiss, 1973; McNeil & Prescott, 1978).

In fact, there have been so many revisions in the original De Renzi and Vignolo test procedure that Berry (1973, p. 4) asserts:

> There is no longer one recognized Token Test. Clinical aphasiology now has a family of Token Tests, related, but not identical twins of their ancestors.

Poeck and his associates (1972, 1973) have investigated the the relationship between the Token Test, type of language disturbance, and non-cognitive variables. Token Test scores of aphasics categorized either into groups with motor, sensory, or anomic aphasia (Orgass & Poeck, 1966; Poeck et al., 1973), or along the dimension of fluency-nonfluency (Poeck et al., 1972) reflected the fact that type of aphasia

apparently did not influence the test performance overtly. Instead, Kreindler et al. (1971) found that only the severity of receptive disorder was inversely related to Token Test performance. After the age of 15, age does not seem to influence Token Test performance (Orgass & Poeck, 1966; Hartje et al. 1973).

Kreindler et al. (1971) tried to analyze specific aspects of the Token Test performance separately: the effects of the shapes, colours and sizes of the tokens, the effects of word position in the commands, and the concrete or abstract aspects of the tokens. They reduced the number of colours in the test to two in order to equate the set size of each of the properties of the tokens. They also modified the test by placing the tokens in a constant random arrangement, and they reduced the task to simply pointing to the tokens which they named in standard word order (for example, 'large yellow circle') or atypical word order (for example, 'yellow large circle'). Lastly, to test the effect of abstractness or concreteness they introduced tokens which could be varied in shape (circle and square) and size (flower and house). Kriendler et al. found that aphasics experienced the greatest difficulty in comprehending (i.e., correctly identifying) the shape (abstract feature) of the token, and least difficulty in comprehending the size (concrete feature)of the token. The word order in the commands also influenced performance, in that the last item named (mostly a noun) was identified most easily. The

atypical word orders were processed as easily as the standard word orders. Here, Boller et al. (1977) suggest that this later finding raises the possibility that short-term memory (STM) deficit may account for some Token Test problems, the authors tested STM independently in all patients and found that none were unable to remember span of three items. Furthermore, Kriendler et al. noted that clinically some aphasics were observed to repeat 'mechanically' the three words of the command while simultaneously pointing to an incorrect choice. This supports Lesser's (1976) assumption that the Token Test does over-tax the reduced auditory-verbal sequencing space of aphasic subjects.

A linguistic approach to breaking down Token Test performance into some of its critical elements was taken by Whitaker and Noll (1972) and Poeck et al. (1974). The findings of these studies suggest that the use of the verb 'touch' may have an implicit meaning (touch with your part of the body) and an explicit meaning which replaces or supplements the understood one (as in example, 'Touch the red square with the blue circle'). Whitaker and Noll (1972) suggest that the high error scores obtained by their subjects on the Token Test reflect their difficulty in shifting from the implicit to the overt instrumental case.

Research studies have generally found the Token Test to be an accurate and sensitive indicator of the presence of receptive deficits in aphasia. Hartje et al. (1973) for

example, reported poor Token Test performance by 91% of aphasic patients, while Boller and Vignolo (1966) found that left brain-damaged patients who did not appear aphasic on standard aphasia batteries performed more poorly than did right brain-damaged patients or normal controls. Performance on the Token Test has been found to correlate with clinical assessments of the severity of aphasia (Orgass & Poeck, 1966) as well as with performance on various standard aphasia test batteries (Swisher and Sarno, 1969; Lesser, 1974), thus establishing its concurrent validity.

Noll and Randolph (1978) administered the Token Test to a group of aphasics to specify the nature of language processing breakdowns by identifying the type of error responses made by aphasic subjects. In their study the test was administered to 25 mild aphasic and 25 matched normal subjects for the purpose of determining the linguistic nature of the auditory verbal comprehension error responses. The aphasic subjects obtained poorer scores on the Token Test than did the normal subjects, with minimal overlap between the two groups. A subsequent psycholinguistic analysis of the error responses for both groups was made on two levels: syntax and semantics. It was revealed that generally aphasic subjects experience the same pattern of difficulty for syntactic constructions (involving *with*, *to*, *from*, and *by*) as do normal adults.

Token Test performance is shown to be unaffected by variables such as age, sex, education, or intelligence of

the patient (Orgass & Poeck, 1966). However, performance on the Token Test appears to be affected by the rate of speech (Parkhurst, 1970; Marckworth, 1976). Marckworth (1976) in her study found that the aphasic performance improved when the instructions of the token test were presented in an expanded form. Toppin and Brookshire (1978) in their study analyzed the performance of 12 aphasic subjects on a delayed response task using commands similar to those found in the Token Test, under Standard, Relocation, and Nonvisual conditions. In Standard conditions, subjects could see the tokens as commands were presented and during delay intervals that were interposed between the end of the command and the subject's response. In Relocation conditions subjects could see the tokens during command presentation and delay intervals, but the tokens were repositioned before the subject was allowed to respond. In Nonvisual conditions, no visual information was available to the subject until the delay interval was over. Results suggested that performance was not significantly affected by the presence of delay except in part III[10] of the test, where aphasics made more errors. These results suggest that aphasic subjects did not rely to any great extent on visual or visual-spatial strategies to perform successfully in the delayed response task. It appears that subjects may have been using some type of verbal strategy to mediate the delay interval, in spite

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[10]Which includes command of the type 'Take the red circle and the green rectangle'.

of their impaired language system.

De Renzi and Faglioni (1978) have established normative data for an abbreviated form of the Token Test developed by them in 1975, by administering the test to 200 aphasic subjects and 215 normal subjects. This shortened version of the Token Test consists of 36 items, reducing the commands in parts I to IV from 10 to 4 and the commands of part V from 21 to 13. Squares were used in place of rectangles and black tokens were substituted for blue tokens in view of the fact that some normal as well as brain-damaged patients may find it difficult to discriminate blue from green (since there were green tokens in the original Token Test, the authors avoided this confounding effect of colour misperception).

In conclusion, Boller et al. suggest that although the Token Test has now been used by many laboratories in the world for well over a decade, the reasons that aphasics tend to perform poorly on it in comparison with groups of other patients and control groups are still not clear. Although quite different types of aphasic patients obtain similar total test scores, no one basic process can be accounted for this performance. A qualitative analysis of each subject's performance can be facilitated by changing the scoring system from an item by pass-fail type of score, as originally proposed by De Renzi and Vignolo (1962), into scoring each aspect of each command separately as proposed by Benton, (1967), or scoring on a 15-point multidimensional

scale as given by McNeil and Prescott (1978).

Disimoni, Keith, Holt and Darley (1975) investigated the practicality of developing short forms of the Porch Index of Communicative Abilities. Stepwise regression procedures were performed using data from 222 complete administrations of the PICA to determine the accuracy of predication of overall scores on the basis of data from either fewer subtests or fewer items. Results indicated that the PICA is highly redundant and that it may be possible to develop useful shorter forms of it. Disimoni et al. think that a short form of the test can be developed which will predict overall score without significant error. They suggest devising several shortened forms of the PICA, using protocols suggested by the data, and administering the complete form and shortened forms to aphasic patients. In this way, the actual effectiveness of some plausible combinations of subtests can be tested.

Lincoln and Ells (1980) have derived a short form of the PICA from results on testing 184 dysphasic patients. Their results of retesting 51 patients indicate that shortening the test produces some loss of sensitivity to change when subtests are considered but negligible loss for the scales or overall score. A complete clinical validation of this short form with control group needs to be established.

Cohen et al. (1977) translated the Sklar Aphasia Scale into German and studied the discriminative and construct

validity of the German version of the SAS. The SAS was administered to groups of fluent aphasics, nonfluent aphasics and three control groups (brain-damaged patients without aphasia). The SAS discriminated fluent and non-fluent aphasics from schizophrenics, brain-damaged and normal control subjects with a high level of confidence. However, the SAS did not discriminate between fluent and nonfluent aphasics.

Shewan and Kertesz (1980) have established the reliability and validity characteristics of the Western Aphasia Battery (WAB). Their results indicate that WAB's Aphasia Quotient scores reliably differentiate between aphasic and control groups, with only a small overlap for high functioning anomic aphasic subjects.

It is evident from the above validation studies that some tests for example, the LMTA, the MTDDA and the Token Test have been subjected to much more experimentation than the other tests currently available, with the result that scores from them may be considered a reliable prognosis if not always interpretable linguistically (i.e., in terms of the actual nature of the language deficit they identify). Such validation is an important aspect of any test.

3.2 Information from research studies in aphasia

A number of research studies are briefly reviewed here, for the purpose of indicating the information they provide for the construction of a test, test tasks, subject groups and testing situation. These research studies have both practical and clinical applications. However, evaluation of such studies in clinical situations has not been attempted so far. It is up to the speech therapist to employ these techniques in rehabilitation. These research studies concern various different subject groups and tasks, and reveal ways to find out the information one wishes to test specifically. From this practical viewpoint the following studies are discussed to highlight their clinical importance. The sentence verification paradigm, the use of pantomime in comprehension testing, text comprehension and use of pictures in sentence comprehension suggest future directions in testing which need to be implemented. Thus the emphasis here is on studies showing confounding variables to be avoided and suggesting test techniques.

Investigations in the area of auditory perception have indicated that certain parameters influence comprehension in normal adults: viz., sentence length (McMohan, 1963), frequency of occurrence of words (Howes, 1957), vocabulary difficulty (Nicholas, 1975), and syntactic complexity of sentences (Miller, 1962; Mehler, 1963; Slobin, 1966). The influence of such parameters as these has been investigated on aphasic populations by Schuell and Jenkins (1961),

Goodglass, Gleason and Hyde (1970) and Shewan and Canter (1971). The results of these studies suggest that syntactic complexity is the most difficult parameter in comprehension testing.

In general it appears that studies involving the comprehension of single words present a somewhat artificial task, in that the comprehension of a word in normal language usage is facilitated by the context in which the word is embedded. Gardner et al. (1975) studied the comprehension of single words in a more natural context by varying several aspects of the sentence in which the word was embedded and found that performance of aphasics was significantly enchanced by the presence of a context. Brookshire (1976) studied the effects of task difficulty on sentence comprehension performance of aphasic subjects. Analysis of the results indicated that presentation of a series of difficult commands interfered with a subject's subsequent performance in response to commands that would ordinarily be very easy. The above studies suggest that variables like: (1) frequency of occurrence of words in English, (2) context in which the test word is embedded, (3) sentence complexity and (4) task difficulty influence the performance of aphasics on comprehension tasks and these variables have to be considered in developing any test for aphasia.

The syntactic comprehension test (Parisi & Pizzamiglio, 1970) purports to measure the subject's understanding of the syntactic structures of heard sentences. Such properties of

the sentences as (1) grammatical units such as prepositions, (2) order properties of words in sentences, (3) bound morphemes such as the plural ending, and other devices are considered. Parisi and Pizzamiglio used a technique proposed by Fraser, Bellugi and Brown (1965) in which the subject is shown a pair of pictures while a sentence is read aloud. One of the pictures is correctly described by the sentence (e.g., 'the boy is pushed by the girl') while the other is identical except for a single syntactic detail (e.g., a change of subject-object relationship: 'the girl is pushed by the boy'). The test also aims to evaluate the knowledge and use of syntactic rules in a systematic way by incorporating the variable of difficulty into the test items. As the authors say, the test aims at 'specificity of information' by giving qualitative and linguistic aspects of the aphasic disorder that will help to plan the therapy effectively. In addition to showing the importance of testing the syntactic aspects of speech, the test also suggests the importance of the use of pictures in comprehension tasks.

The multiple-choice semantic discrimination test (Pizzamiglio & Appicciafuoco, 1970) includes materials that reveal semantic similarity among the words. The test based on word-associations (Kent & Rosanoff, 1910) determines to what extent a subject has available a normal pattern of associated words and suggests the importance of multiple-choice techniques in assessing semantic functions.

Naeser's (1974) phonemic discrimination test involves matching target words with the pictures presented to the subject and the results of such studies are mainly of research importance, rather than helping towards any rehabilitative program of study.

The pantomime recognition test was developed by Duffy, Duffy and Pearson (1975) to study the extent of impairment of pantomime recognition and the relationship between pantomime recognition and verbal deficits in aphasia[11]. This test requires no verbal instructions to the subject and only a simple pointing response, as it is mainly meant to be a receptive test.

Currently available tests of pantomime behavior use procedures that limit their appropriateness or validity as measures of pantomimic competence for the aphasic (Duffy et al.). So far four tests of pantomimic performance have been developed (Pickett, 1962; McCarthy& Kirk, 1968; Porch, 1967; and Goodglass & Kaplan, 1963). All four tests use verbal instructions to the subject and, except for two subtests, they all expect the subject to respond with some type of pantomimic act. These tests may be invalid with aphasics, as they may fail to understand the instructions due to impairment of verbal comprehension or a motor apraxia. The Duffy, Duffy and Pearson test avoids such restrictions by (1) using non-verbal procedures to train the subject in the

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[11]Pantomime refers to the use of nonverbal motor behavior to convey messages.

test task and (2) assessing pantomimic competence through receptive rather than expressive channels and using only a simple motor response, that is, pointing. De Reuch and O'Connor (1963) pointed out the importance of this latter restriction, saying that a 'non-verbal test should be presented without words to the person to be tested, and that the responses of the person should be given by actions without words.'

The pantomime recognition test consists of 50 test items. The test items are pictures of common objects whose use can be pantomimed by an examiner; for example, drinking glass, scissors, fork and gun. The use of each object is pantomimed by the examiner and the subject demonstrates his recognition of the pantomimed act by pointing to a picture of the object in use. This test is an important research tool because subjects who can not express ideas verbally can express the same through non-verbal means.

The text comprehension test developed by Stachowiak, Huber, Poeck and Kerschensteiner (1977) determines the performance of aphasic patients on comprehension of texts. The test consists of 26 stories, each being presented with a multiple choice set of five pictures. The topic of each story relates to an everyday event or situation, such as an office employee getting himself involved in too much work or a man losing all his money playing cards. In the construction of the texts, two characteristic features of connected discourse are used, namely, syntactic coreference

- which enables the hearer to identify the persons, objects and events spoken about in terms of the pronouns used, and idiomatic comment - the reference of which the hearer has to deduce from a preceding sentence. For example, the German sentence literally meaning, 'He has prepared a nice soup for himself' and metaphorically meaning, 'He has made a nice mess for himself' is used to describe the self-inflicted difficulties of an overworked clerk. Here, the task consists of choosing five alternative pictures a man eating soup, a girl at a neat desk, a man at a neat desk, a man in a shop and finally the appropriate representation of a man at a desk piled with papers. The results of this study revealed the fact that in the presence of a context aphasics perform like normals. In consequence, it is concluded that the redundancy of text makes up for the difficulties aphasics have in comprehending the isolated words and sentences. This study highlights the importance of using redundant information (as given by the text) in comprehension tasks.

De Renzi and Ferrari (1978) have devised the Reporter's Test in response to the notion that, 'the ability to speak in connected sequences of words provides the critical dimension to assess the patient's communicative level.' Accordingly, the Reporter's Test requires the patient to report verbally to a hypothetical third person the actions that the examiner is performing on an array of tokens, so as to enable that third person to replicate them. These performances correspond for the most part to the commands of

the Token Test. The aim of the task is to have the patient produce connected sequences of words, the choice and order of which is determined in advance and can be easily scored. Such a technique offers information for correlating the logical sequence of events and the type of sentences used by the individual. However, a possible drawback of the test is that it involves a very limited number of words and does not tap, consequently, the wealth of the vocabulary available to the patient.

Goodglass, et al. (1979) have attempted the development of a test for investigating 'the effect of syntactic encoding on sentence comprehension in aphasia.' Their study compared two levels of syntactic encoding with respect to the effect of these on aphasic auditory comprehension. The same informational content was presented either as a reduced sentence (e.g., the boy is walking and reading), or as two conjoined simple propositions (e.g., the boy is walking and he is reading). A similar contrast was utilized to compare sentences containing relational terms of time, comparision, and instrumentality as well as sentences involving conjunction reduction with parallel messages expressed in expanded, simplified form (e.g., the truck arrived before the bus *versus* the truck arrived first and then the bus). A picture-verification paradigm was used for testing. Comprehension was significantly enhanced in the case of sentences expanded to conjoined simplex propositions. In general, the results revealed that the expansion of a

sentence into two simple propositions favoured comprehension among Broca's aphasics. Thus, the use of expanded sentences in comprehension tasks may provide a better measure of the comprehension process.

The sentence verification task devised by Brookshire and Nicholas (1980) is a technique for assessing comprehension of spoken language. This sentence verification procedure has been used extensively in examining sentence comprehension by normal listeners, and the existing literature suggests that sentence verification may provide new insights into how an aphasic person approaches the problem of extracting meaning from spoken or written verbal messages.

In the sentence verification task, the individual is asked to judge whether sentences are true or false, either on the basis of the individual's general knowledge (using sentences such as 'the winter is colder than summer') or with reference to a picture presented along with the sentence 'the boy is pushing the girl'. Employing such a task, Brookshire's study used aphasic and nonaphasic subjects participating in a sentence verification task to judge whether spoken sentences correctly described pictures presented with the sentences. True active and true passive sentences were presented, as well as false active and passive sentences in which either the subject, verb, or object did not match the pictures presented. Subject's response accuracy and reaction times were recorded. Passive

sentences were more difficult than active sentences for both groups. Both groups appeared to be processing sentences for meaning as they were received, rather than waiting for the entire sentence before beginning to process it for meaning. In general, performance of aphasic subjects resembled that of nonaphasic subjects, except that aphasic subjects consistently took a longer time to verify sentence meaning than nonaphasic subjects.

The Picture Story Test was designed by Gleason, et al. (1980) to facilitate the production of connected discourse by subjects with aphasia. The Picture Story Test incorporates a general investigative method to show the subject a series of cartoon like-pictures that illustrate a brief story, and to read or tell the subject a standard version of the narrative. The subject is then asked to retell the story, while looking at the pictures, and his version is tape recorded for transcription and analysis. In their study Gleason, et al. analyzed the narratives produced by 15 subjects for thematic sequence, syntactic organization, and for the presence of various lexical features. With this the authors claim that Picture Story Test is a clinically useful technique in estimating the connected narrative, i.e., the use of nouns, verbs, pronouns etc. It is indeed a good tool for eliciting spontaneous speech which can be incorporated in future tests with different interpretations.

3.3 Conclusions

The review done in sections 1, 2 and 3 of this chapter points to the following problems in the area of testing, which remain unresolved:

1. The different tests on aphasia point to the lack of an agreed-upon language model (for describing the knowledge of the coding elements and their meaning) on which the data are based. Some tests are explicitly based upon language models; others do not state their assumptions about the language models.
2. Validity studies for some standardized tests are lacking. Some tests for which validity studies are available employ poor statistical methods, viz., factor analysis in which the factors interpreted depend on the author's conception of the language model and the behavior which the test should assess. This points up the necessity of a rigorous validity study for any proposed new test.
3. There have been many individual research studies aiming at the development of new tests for studying particular aspects of the language comprehension or production process. These studies, some of which suggest therapeutic guidelines, have not been applied in therapy. However, the majority of these research studies, for example, by Brookshire and Nicholas (1979) and Stachowiak et al. (1977) shed light on the type of tasks to be considered in constructing any test on

aphasia. The ones of particular interest to this study have been discussed above.

4. METHODOLOGY

The methodology of the present study is described under the following headings:

1. Development of the test materials .
2. Clinical validation of the psycholinguistic test.

4.1 Development of the test materials

The development of the test materials is based on the Information Structure model of language described in Chapter One. Accordingly the test tasks are designed to elicit language coding structures associated with the four different levels of information, in light of the following considerations: (1) to provide a fairly comprehensive examination by incorporating such tasks as spontaneous speech; (2) to provide detailed tasks for both comprehension and expression, so that the exact measure of performance level is obtained; (3) to include tasks which consider the possibly limited response repertoire of aphasics and thus make use of gestural ability of aphasics; (4) to generally include three examples in each type of question; (5) to encourage the patient to respond either by repeating a question (to which there is no response initially) twice, or by cuing the response by giving a sentence frame such as

'This is a ...'; (6) to note any delay or cue on the tasks as additional information[12]; and (7) to include tasks that range in difficulty so that the tests go from easiest to the hardest[13]. This notion appears to be parallel to the language structures involved in the information levels, i.e., from denotational information to the contextual information.

The test eliminates tasks pertaining to articulatory impairments and impairments of linguistic function on other sensory modalities as they are not considered to be the central part of the linguistic process. Thus the tasks eliciting information on apraxias or dysarthrias are not considered. As the test aims at considering the gestural responses, the responses that can not be conveyed through gestures are eliminated . In consequence, no account is made for the details of phonological aspects. Instead, the test tasks developed here mainly aim at eliciting the knowledge of the linguistic information all along the lines of the Information Structure model and the structures that encode them. An evaluation of these specific tasks developed are given in terms of their results in Chapter Six. The details

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[12]This is a possible device to see that the test score is not affected while 'encouraging the patient to respond' either by cuing or by repetition.

[13]The range of difficulty was statistically determined by analyzing the ranking data on the test tasks obtained by the performance of normals. A small questionnaire given to normal subjects also indicated the tasks that take less time to respond to than the others which take more time. This is discussed further in Chapter Six.

of the tasks[14] developed are presented in the following sections.

4.1.1 Tests for denotational information

Rationale:

The tasks here are designed with the aim of tapping information on the subject's vocabulary and his ability to deal with notions of modification or identification and restriction. The ability to attend to and respond to objects that are familiar in the surroundings (e.g., nouns) is considered important here. Similarly understanding and expressing verbs (action verbs), adjectives, prepositions, adverbs, modifiers of nouns (number and gender) and negations are considered to reflect the level of the knowledge of denotational information and the ability to comprehend and produce the linguistic structures appropriate to it.

4.1.1.1 Tests for comprehension

Scoring:

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[14]Detailed information regarding the test materials and their scoring (test protocol and pictures in black and white) and the expected responses (obtained after having tested the normals) are included in Appendices A, B and C respectively.

0-No response.

1-Incorrect response.

2-Correct response to gestural instructions.

3-Correct response to verbal instructions.

This method of scoring is applied to all the tests on comprehension.

Scoring rationale

Here the rationale is that in a testing situation (especially with the aphasic patient) there are four possible types of responses, viz., (1) the correct verbal response, (2) the correct gestural response, (3) an incorrect response and (4) no response. In the above four categories of possible responses, No. 1 gets the priority being the highest in a hierarchical order since it stands for the correct verbal response that is required in a language test and hence gets a score of 3 from the range of possible choices. The gestural response is given a score of 2, because it is considered as a communication mode and it is always better than an incorrect response. An incorrect response is in turn better than 'no response' as it indicates the person's ability to verbalize. For comprehension tasks the ability to understand verbal instructions is considered the most important followed by the ability to respond to gestural instructions, incorrect response and no response categories.

1. Comprehension of nouns.

Procedure:

The familiar objects are displayed in front of the subject and the subject is asked to point to any three of them as named by the tester one at a time. The objects used here are coin, spoon, pen, fork, pencil, matches and key.

Reference; MTDDA, LMTA, PICA, Zimmerman et al., 1969.

2. Identification of the body parts.

Procedure:

The subject is asked to point to any three of the body parts according to the instructions given here: 'Show me your eyes, foot, nose, ear and hand.' (Here each body part is mentioned one at a time.)

Reference: Eisenson, 1954.

3. Recognition of verbs.

Procedure:

Show the subject three action pictures and ask him to answer the following questions by pointing to the correct answers.

a. Which picture shows someone drinking?

b. Which picture shows someone jumping?

c. Which picture shows someone playing?

Refer to picture No. 1 in Appendix B.

4. Recognition of time: past and present.

Procedure:

Show two pictures and two test sentences depicting the past and the present tense and ask the subject to point to the picture described by the test sentence. Examples of the test sentences used are: (3) He has broken the dish and (4) He is breaking the dish.

Refer to picture No. 2

5. Recognition of adjectives.

Procedure:

Show the subject four pictures one at a time and ask the following questions for which the answers could be pointed out.

a. Show me the big house.

b. Show me the short woman.

c. Point to the small ball.

Refer to picture No. 3

Reference: Zimmerman et al., 1969.

6. Recognition of ADJ+N collocations:

Procedure:

Show the subject three pictures (picture of a white cat, picture of a black cat and picture of a striped cat) and ask him to point to the picture appropriate to the following instruction:

'Show me *the black cat.*'

Refer to picture No. 4

7. Identification of N+REL CLAUSE collocation:

Procedure:

Show the subject three pictures and ask the subject to respond to the instruction 'show me the dog *that is barking.*'

Refer to picture No. 5

8. Recognition of prepositions.

Procedure:

Show the subject three pictures and present three sentences both orally and visually[15] (the sentences are presented in written form on a card) and ask the subject to point to the picture that describes the

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[15]The sentences are presented visually because the aphasic subject will be able to read the stimulus sentence and then answer in case he has failed to hear the sentences presented orally to him. This way the sentences which generally involve more than one word may be less taxing to comprehend on the part of the aphasic subject.

sentence.

a. The apple is under the box.

b. The apple in on the box.

c. The apple is in the box.

Refer to picture No. 6

Reference: Lado, 1967.

9. Recognition of adverbs.

Procedure:

Show the subject three pictures indicating adverbs of manner and location. Then give the stimulus sentence and ask the subject to point to the picture that depicts it.

a. The boy is here.

b. The girl walks slowly.

c. The boy is there.

Refer to picture No. 7

Reference: Parisi and Pizzamiglio, 1970.

10. Identification of noun number.

Procedure:

Show the subject six pictures depicting the singular and plural of nouns and ask the following questions:

a. Point to the picture of balls.

b. Point to the picture of a glove.

c. Point to the picture of watches.

Refer to picture No. 8

Reference: Zimmerman et al., 1969.

11. Identification of categories.

Procedure:

Show the subject five pictures belonging to different categories of nouns and ask him to sort out the pictures that belong to individual categories ('Sort these pictures into groups of things that are alike'). The examples of the categories are: shapes and clothing.

Refer to picture No. 9

Reference: Goldstein & Sheerer (1941), and Pizzamiglio & Appiciafuoco (1970).

12. Identification of negations.

Procedure:

Present an action picture and cards with an affirmative sentence (not describing the picture) and a negative sentence and ask the subject to point to the correct response. An example here is the picture illustrating the action of 'eating'; and the test stimuli are: 1) he is drinking water and 2) he is not drinking water.

Refer to picture No. 10

Reference: Lado, 1967.

4.1.1.2 Tests for expression

Scoring:

0-No response.

1-Incorrect response.

2-Correct gestural response.

3-Correct verbal response.

This method of scoring is the same for all the tests on expression. In all the tests for expression the subject is allowed to respond through gestures if verbal answers cannot be given.

1. Naming the nouns.

   Procedure:

   Show the subject ten familiar objects viz., pen, pencil, comb, spoon, knife, matches, key, watch, and coin and ask the subject to name any three of them according to his choice.

   Reference: LMTA, MTTDA and PICA.

2. Expression of number of nouns.

   Procedure:

Show the subject pictures illustrating the noun number in the following way:

a. Picture 1. (examiner) Here is a box (fan). What is it?

(subject) ...a box (fan).

b. Picture 2. (examiner) Now there are two of them; so, there are two .....(subject's response)boxes or fans as the case may be.

Refer to picture No. 11

Reference: Berko, 1958.

3. Expression of body parts.

Procedure:

Ask the subject to name any three of his body parts.

4. Expression of verbs.

Procedure:

Show the subject three objects and ask him to describe 'what they are used for', by giving a suitable word that best depicts its use. The example of the objects are: pen, spoon, and key.

Reference: Goodglass & Kaplan, 1972.

5. Expression of time: the past and the present.

Procedure:

Show the subject two pictures depicting the past and the present tense of the verbs and ask them to respond to the following questions:

a. What is he doing in this picture?

b. What has he done in this picture?

Refer to picture No. 12

6. Expression of adjectives.

Procedure:

Present four pictures and a sentence frame and ask the subject to supply the appropriate word to complete the sentence.

a. This is a ..... spoon.

b. An elephant is a ..... animal.

c. He is a .... man.

Refer to picture No. 13

Reference: Lado, 1967.

7. Expression of categories.

Procedure:

Give the subject the names of two categories and ask him to give five names that belong to each category. Examples of the categories are: colours and animals.

8. Expression of adverbs.

Procedure:

Show the subject pictures which will elicit adverbials as a response to "how" or "where" questions (manner and location) and ask him to answer to the following questions:

a. How does the train move?

b. Where is the picture of a horse?

c. How does the girl pull the rope?

The range of acceptable answers for question 'a' (on the track, fast, or by steam) are determined through responses given by normal subjects.

Refer to picture No. 14

9. Expression of negations.

Procedure:

Show the subject an action picture and describe it by giving an affirmative sentence. The affirmative sentence describing the picture might be 'the girl is writing'. Then ask the subject the question 'Is the girl reading?' A 'No' response is considered as the key response.

Refer to picture No. 15

10. Expression of prepositions.

Procedure:

Show the subject three pictures and ask the subject to give the exact word to fill in the sentence frame.

a. The cat is ..... the chair.

Refer to picture No. 16

Reference: Lado, 1967 and Lee, 1971.

The determiners forming a part of the denotational information are tested on 'naming the noun task', the assumption being that a normal response to a question 'what is this'? will be a DET+N collocation, and not just a noun alone. The relative noun clause is included under the comprehension test. The expression test does not include it, in view of the fact that it is difficult to verbalize such instructions to aphasic subjects. Different types of aspect and tense/modals are not included because they are difficult to describe through pictures and elicit convenient responses for.

4.1.2 Tests for relational information

Rationale:

These tests elicit information on the expression and comprehension of grammatical roles of subject, object, and predicate. Comprehension and expression of these elements are considered important in assessing communicative ability.

4.1.2.1 Tests for comprehension

In each task on relational information described below only one example is included under each subtest.

Procedure:

1. Comprehension of the grammatical relations of subject and direct object.

   Show the subject SUBJ/DO reversible pictures with one of the two sentences depicting the picture and ask the subject to point to the correct picture. Here the examples are: (1) A dog is chasing a cat (2) A cat is chasing a dog.

   Refer to picture No. 17

2. Comprehension of the grammatical relations of subject, direct object and indirect object.

   Procedure:

   Show the subject SUBJ/DO/IO reversible pictures with one of the two sentences depicting the picture and ask the subject to point to the picture described by the sentence. Here the examples are: (1) John gave flowers to Mary and (2) Mary was given flowers by John.

   Refer to picture No. 18

4.1.2.2 Tests for expression

1. Expression of the grammatical relations of subject, direct object and indirect object.

   Procedure:

   Show the subject a picture and together identify elements in the picture (e.g, John, Sue, book[16]) and ask the subject to tell what is happening in the picture. The correct production of SUBJ, DO and IO are scored even if the patient gives the pronoun forms.

   Refer to picture No. 19

4.1.3 Tests for sentential information

Rationale

Comprehending and expressing the different types of sentences indicates grammatical knowledge. In normal communicative situations, sentences of different types (imperatives, interrogatives, and declaratives) are often used and they form the level of sentential information. The following tasks are designed to elicit whether the patient

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[16]Here the lexical elements are given to the subject to make sure that he does not give the lexical forms instead of describing the relationships among them. In this way the word finding tasks are separated from the relation association tasks.

retains the appropriate coding forms to express these functions.

4.1.3.1 Tests for comprehension

1. Comprehending the imperative.

Procedure:

The subject is asked to follow these commands:

a. Stand up.

b. Make a fist.

c. Point to the ceiling.

Reference: Eisenson, 1954.

2. Comprehending the declaratives:

Procedure:

Show the subject pictures of (1) a man reading a book, (2) a book, (3) a man, and ask him to point to the picture that depicts the sentence 'The man is reading a book'.

Refer to picture No. 20

3. Comprehending the interrogatives.

Procedure:

Present the subject two yes/no questions and ask him to answer to them by saying yes or no, or by nodding the

head.

a. Do babies sleep?

b. Do cows fly?

Here pictures of the major lexical items (cow and baby) are also provided.

Refer to picture No. 21

For WH-questions, a picture is presented and the subject is asked to respond to the following questions by pointing to the answers.

a. Who struck the car?

b. Whom did the car strike?

Refer to picture No. 22

Reference: Brookshire & Nicholas, 1980.

4.1.3.2 Tests for expression

1. Expression of declaratives.

Procedure:

Ask the subject to describe the pictures presented to him. (The girl is swimming, the girl is sleeping and the boy is washing his face)

Refer to picture No. 23

2. Expression of imperatives:

Procedure:

Show the subject two hand puppets (Joe and a dog) and give the following instructions:

a. Joe, tell the dog to lie down.

b. Joe, tell the dog to look up.

c. Joe, tell the dog to close his eyes.

3. Expression of interrogatives.

Procedure:

Show the subject two hand puppets (Joe and a dog) and instruct as follows:

a. Joe, ask the dog where the postoffice is.

b. Joe, ask the dog what time it is.

c. Joe, ask the dog if it is an animal.

d. Joe, ask the dog if he can bark.

4.1.4 Tests for contextual information

Rationale

With these subtests it is hoped to tap appreciation of (1) the given-new strategy (phrase order in sentences), (2) focus, as indicated by contrastive stress and (3) topic, as given by clause-initial placement.

4.1.4.1 Tests for comprehension

1. Identification of given/new strategy.

Procedure:

Show the following two pictures and ask the subject to point to the pictures describing the following sentence.

a. It is the boy who is petting the cat.

b. It is the girl who is petting the dog.

Pose the subject the following questions and ask him to point to the correct response.

Who is petting the cat?

What is the boy petting?

Refer to picture No. 24

2. Identification of topic.

Procedure:

Show the subject several pictures (picture of an umbrella, man hitting the woman with an umbrella, a lady folding an umbrella and a lady holding an umbrella) and ask him to point to the picture that depicts the topic common to all pictures.

Refer to picture No. 25

4.1.4.2 Tests for expression

1. Expression of given/new strategy.

Procedure:

Show the subject the following pictures and ask the following questions: (here the subject is asked to respond verbally)

Who is petting the cat?

What is the girl petting?

The boy is petting the cat. (given: x is petting the cat; new: the boy)

It is the dog the girl is petting. (given: girl is petting; new: the cat)

Refer to picture No: 26

2. Expression of topic.

Procedure:

Show the subject the following test sentence and the pictures (picture of a cat, a cat on the desk, a lady holding a cat and a lady showing a cat to her child) and ask the subject to describe the common topic to all the pictures.

Refer to picture No. 27

3. Expression of focus.

Procedure:

Ask the subject to narrate a small story for 2-3 minutes and record the same. The narration was analyzed on the following lines:

1. Complete narration of any topic with correct sentences, stress and intonation - a score of 3.

2. Incomplete narration with gestures substituted - a score of 2.

3. Incomplete sentences with no meaning and stress - a score of 1.

4. Jargon responses - a score of 0.

Control tests:

Rationale: Here the control tasks are considered to be a part of the contextual information as they emphasize on the use of one's knowledge of the world, given-new strategies and focus etc.

1. Present the subject with pictures depicting a logical sequence and ask him to arrange the pictures in a sequential order.

Refer to picture No: 28

2. Ask the subject to describe the logical sequence of a set of pictures.

Refer to picture No: 29

3. Show the subject a picture and ask him to describe what is happening in that picture.

Refer to picture No: 30

4.2 Clinical validation of the psycholinguistic test for aphasia

The clinical validation of the psycholinguistic test for aphasia aims to answer the questions of validity and reliability. Here the term validity refers to whether or not a test measures what it purports to measure, and reliability refers to whether or not the test scores are stable for the same individuals. In general, validity is a matter of relevance. Is the test relevant to what it claims to measure? There are four types of validity to be established in the construction of any psychometric test (Cronbach, 1972). They are:

1. Content validity
2. Construct validity
3. Concurrent validity
4. Predictive validity.

Content validity is evaluated by determining how well the content of the test samples the class of situations or the subject matter about which conclusions are to be drawn.

Construct validity is evaluated by investigating what psychological qualities a test measures, i.e., by determining the degree to which certain explanatory concepts

(constructs) account for performance on the test. The construct here is language.

Concurrent validity is evaluated by determining how the test scores compare with the scores of standardized tests in the same field.

Predictive validity is evaluated by determining how the test results relate to the behavior which the test assesses.

The type of reliability that is being tested chiefly refers to test-retest reliability. This is evaluated by comparing the performance of the same individuals on the test in two different situations in order to demonstrate the stability of the test scores.

In the present study, three types of validity viz., content validity, construct validity, and predictive validity are established. The test-retest reliability is difficult to establish with the aphasic group since there could be a change of performance owing to spontaneous recovery over a period of time. The concurrent validity is not attempted since it is considered that no appropriate linguistically based test on aphasia is available and the development of the present test hopes to fill that gap. As the present study is devised as a test for aphasia, clinical validation in terms of content validity and predictive validity are considered important. These different types of validity are established by carrying out several experiments suited to the explicit questions stated in Chapter One and by considering the following variables:

4.2.1 Subjects

Three groups of adult (above age 15) subjects were used for the study: 30 normals, 30 brain-damaged nonaphasic patients and 30 brain-damaged aphasic patients.

4.2.1.1 Normal control group

The normal control group (subjects without brain damage) consisted of 30 normals of whom 20 were young adults and 10 were senior citizens. An additional ten young adults formed the normal group for ranking test tasks on a scale of 1 to 9 (these data were used for estimating the difficulty level)[17]. The normals were free from medical care and showed no disorder in either language or consciousness. All the subjects in this group spoke English as their mother tongue. Other information on age, sex, eductional attainment, and languages known was collected from the subjects[18] and this is given in Table 1.

4.2.1.2 Nonaphasic brain-damaged patients

This group included 30 brain-damaged patients seen at the Alberta Hospital, Ponoka, and Glenrose Hospital, Edmonton. The criteria for selecting the brain-damaged population required that all the patients (1) be diagnosed as brain-damaged on medical grounds, (2) be more than 15 years in age, (3) speak English as their mother tongue or have used English since childhood, and (4) be cooperative to

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[17]The related questionnaire used is given in Appendix D.
[18]The details of the subject information sheet are given in Appendix E.

TABLE 1

Details of the Subjects Tested

Groups	No.	Sex M	Sex F	Age range	Educational Attainment	Languages Known	Types	Onset* Chronic	Onset* Acute
Normals	30	3	27	16-85Yrs.	Grade V to Univ. Level	English** Ukrainian German French	20-Young Adults 10-Senior Citizens		
BDNA	30	22	8	17-76Yrs.	Grade II to Univ. Level	English** French Ukrainian Russian Finnish	MVA - 7 CVA - 9 OTH - 14	17	13
BDA	30	20	10	20-82Yrs.	No Formal Education to Univ. Level	English** Ukrainian French Greek Polish German	MVA - 4 CVA - 19 OTH - 7	14	16

* For brain-damaged patients only.

** Mother tongue was English or had used English since childhood

testing situations. In this group, some subjects had diffuse brain damage and others had focal brain lesions. None showed any signs of aphasic disturbance, impaired consciousness or dementia. This group of subjects and the other independent variables concerning them are given in Table 1.

4.2.1.3 Brain-damaged aphasic patients

This group consisted of 30 patients diagnosed as aphasics by speech therapists working with the respective cases. The criteria used in selecting the brain-damaged nonaphasic patients were employed here too. However, patients with impaired consciousness were not included in this group. The clinical diagnosis made in the hospitals or clinics on the basis of the usual, informal methods of examination in terms of etiology was also considered. For most patients, the neurological data related to localization of lesion were not available. Consequently it was not included in this study. The details of these subjects' independent variables are given in Table 1.

4.2.2 Method

The testing procedure involved the elicitation of verbal and nonverbal responses to the various tasks of comprehension and expression. The test stimuli consisted of verbal instructions[19] accompanied by visual material (pictures cards in black and white and hand puppets, as

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[19]The relevant scoring sheet is given in Appendix F.

discussed earlier). The testing procedure was carried out on an individual basis. The instructions for each task on the test remained the same for all three groups of subjects. The testing procedure started with the first section of the test and then proceeded sequentially to the other ones. The test was stopped if an individual failed on three consecutive tests under each section.

The entire testing session with the aphasic patients was tape recorded. The time taken by the aphasic patients was also noted. The subjects were not subjected to any kind of physical exhaustion while testing. The performance of each subject was recorded and scored as given in the beginning of this chapter. The tasks eliciting contextual information and the control tasks were recorded for all the subjects, and later analyzed on an individual basis. The test was administerd by the researcher, Mrs. M, a registered speech pathologist with experience in the administration of tests to normals and clinical groups.

For statistical analysis, the scores obtained on the Psycholinguistic Test for Aphasia (PLTA) were regarded as constituting an interval scale. Hence the present data were analysed by means of parametric statistical methods. However, Friedman statistics and Wilcoxon Sign Rank Test (examples of non-parametric methods) were used to analyze the ranking of tasks done by thirty normals. The statistical package program namely the Biomedical Computer Programs (BMDP - 79, Dixon & Brown, 1979) was used for computing

mean, standard deviation (S.D.), and t-scores. The Statistical Package Program for Social Sciences (SPSS, Nie et al., 1975) was used for computing the Discriminant Function Analysis (DFA). The results of these statistical computations are discussed in the next chapter.

5. RESULTS

5.1 PLTA scores in normal subjects

5.1.1 Normative data

The test scores obtained with thirty normal subjects (twenty young adults and ten senior citizens) together with their means and standard deviations are given in Table 2. Here the means and standard deviations are calculated separately for the overall comprehension (combined denotational, relational, sentential and contextual subtests) and overall expression (denotational, relational, sentential, contextual) scores.[20] As shown in Table 2, the mean for comprehension score is 131.07 and that for expression is 130.27. The smallest value obtained for expression and comprehension (124.00 and 117.00 respectively) is given by a senior citizen staying in a nursing home. The subject is female, aged 79 years with grade V education to her credit. It is possible that some emotional problems coupled with age might have led her to obtain the smallest scores compared to others in her group.

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[20]This was done because the overall scores on both comprehension and expression tasks equal to 132.

TABLE 2

PLTA Scores for 30 Normals

Variable Name	Total Freq.	Mean	S.D	Smallest Value	Smallest %Score	Largest Value	Largest %Score
Comp. Score	30	131.07	2.21	124.00	93.94	132.00	100
Exp. Score	30	130.27	3.24	117.00	88.64	132.00	100

KEY

Comp. Score = Comprehension Score

Exp. Score = Expression Score

The maximum scores obtained by normals equal 100% (132 on both comprehension and expression tasks). Thus, the normal responses range from 93.94% to 100% for comprehension tasks and 88.64% to 100% on the expression tasks. The above results support the hypothesis given in Chapter One that normals obtain maximum scores on the PLTA test.

In order to investigate the differences in performance depending on the variables of sex (male, female), age (young - 15-40; middle - 40-60; old - 60 & above), educational level (elementary - completed grade 0-7; high school- 8-12; university - above 12) and languages known (one or more than one), means and standard deviations under each independent variable were computed. Table 3 gives the means and standard deviations for all the different variables computed for the overall comprehension and expression scores. A superficial examination of the means and S.D. values reveals no significant difference in means or S.D values among the four variable categories. T tests for the significant difference between means were not computed since the number of individuals was too small for some variable categories. For example, in the 'sex' category the number of females was 27 and the number of males was 3. Thus, irrespective of sex, age, educational attainment, and languages known, normals seem to obtain good average scores on the test which range from 93.56% to 100% in terms of the mean values.

TABLE 3

Means and Standard Deviations for Variable Groups with Normal Subjects

No.	Variables	Types	Sample Size	Comp.Score Mean	Comp.Score S.D.	Exp.Score Mean	Exp.Score S.D.
1	Sex	Female	27	130.96	2.31	130.07	3.36
		Male	3	132.00	0.00	132.00	0.00
2	Age	Young	19	131.58	1.26	131.16	1.39
		Middle	2	132.00	0.00	127.50	6.36
		Old	9	129.78	3.38	129.00	4.80
3	Education	Elementary	2	125.00	1.41	123.50	9.19
		High	9	131.33	2.00	129.67	3.00
		University	19	131.58	1.26	131.26	1.37
4	Language	Monolingual	20	131.20	2.09	129.60	3.78
		Bilingual	10	130.80	2.53	131.60	0.84

5.1.2 Range of normal responses

The range of normal responses obtained for the thirty normals on the expression tasks are given in Appendix C. These responses formed a basis for comparing the responses obtained with the clinical group. As the responses illustrate, for a task eliciting the adverbial response (e.g., Where is the picture of a horse?) the possible responses are: here, there, in a meadow, and in the mountains. These were all considered correct responses as they all indicated the adverbial form of expression. Here in most cases pictures were used to provide the visual description of the given situation.

5.1.3 Ranking data

Thirty young adults (mostly university students) ranked the test tasks (totalling 39) for difficulty on a scale of one to nine, one being the easiest and nine being the hardest. In the ranking procedure, the control tasks were eliminated as the ranking was also intended to elicit the information on the hierarchy of different information categories, viz., denotational, relational, sentential and contextual with respect to the psycholinguistic model of language described in Chapter One.

The ranking data was subjected to a Friedman two-way analysis of variance (Siegel, 1956). Table 4 gives the results of the Friedman test. The Friedman test statistic of 344.73 is significant at a $p \leq 0.05$ level and it indicates

TABLE 4

Friedman Two-Way Analysis of Variance: Test Results

Variable No.	Number of Subjects	Friedman Test Statistic	Level of Significance
39	30	344.73	0.00***

Interpretation: The ranks differ significantly.

that rank totals differ significantly. To determine the relative differences among the various tasks, the ranks were plotted on a graph in their ascending order, as shown in Figure 1. Table 5 lists the tasks and their description in the ascending order of their ranks. Table 5 shows that most of the tasks relating to denotational information (Id) group together first, and later there are tasks relating to other levels. However, some expression tasks at the Id level (e.g., the tasks eliciting the adverbs, tense, categories, adjectives, and negations) rank high. It is posssible that because for these tasks more than one response (as shown in Appendix C) is possible, and subjects wonder what the examiner will judge "correct", normals rank them toward the 'hardest' end of the scale. The sentential information tasks, especially the expression of interrogatives, and imperatives rank high because the tasks here incorporate hand puppets which may be an artificial situation compared with the tasks involving pictures. Expression of focus - the task eliciting spontaneous speech - is ranked the highest, perhaps as in this test item no specific stimuli are provided in the task. Normals may feel such tasks are highly demanding or not as transparent as more easily stated tasks, and hence rank them as the hardest of all the tasks. From the ranking data it is clear that denotational tasks (mainly involving one word utterances) separate from the others (involving two words or sentential utterances) to a great extent. This supports the model's assumption that

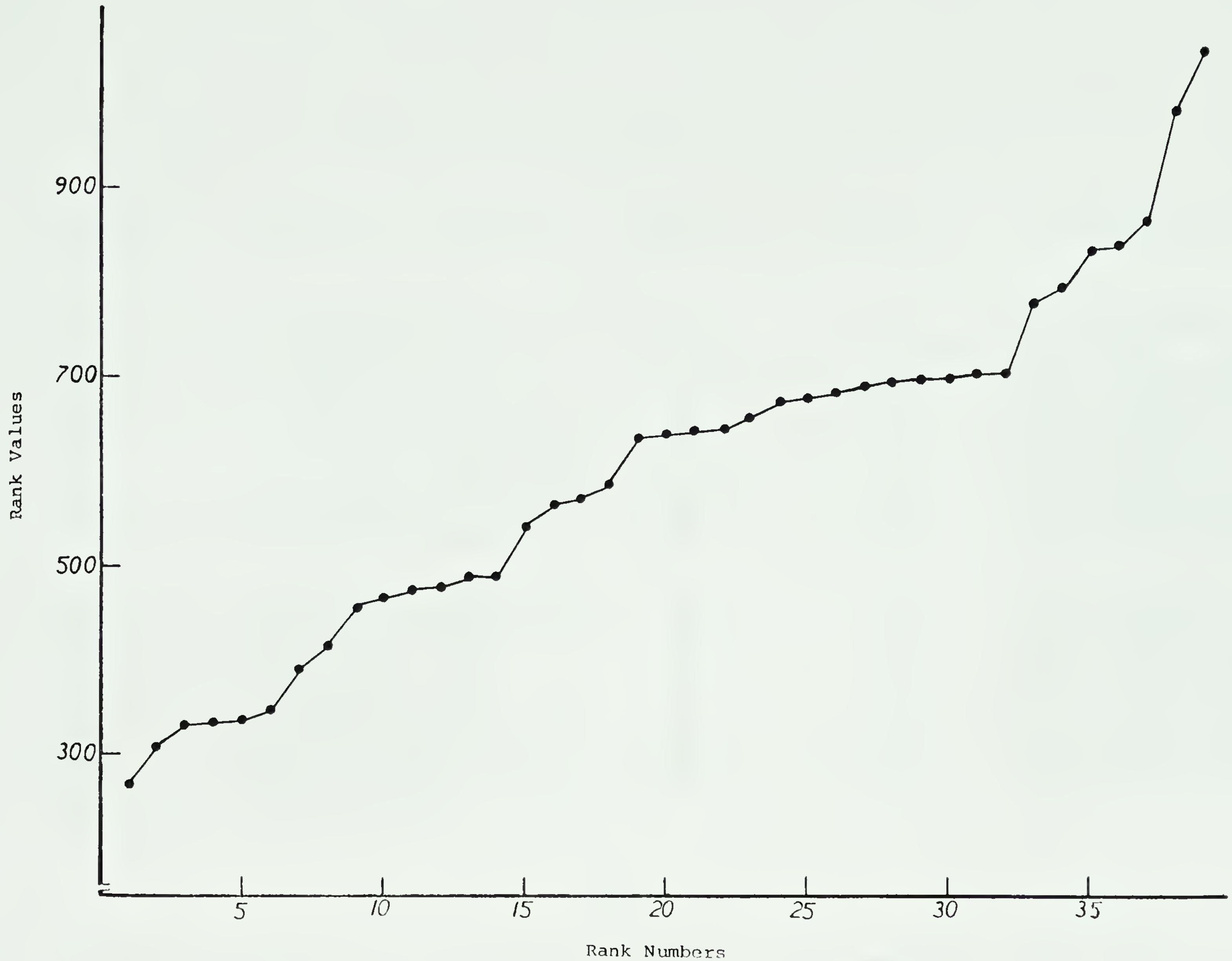

Figure 1. Plot of Ranks in Ascending Order

TABLE 5

Tasks in an Ascending Order of their Ranks

Rank No.	Task No.	Description of the Task	Rank No.	Task No.	Description of the Task
1	1	Id of Nouns - DIC	21	37	Ex of Given/New - CIE
2	2	Id of Body Parts - DIC	22	27	Ex of Topic - CIE
3	13	Ex of Nouns - DIE	23	31	Id of Interrogatives - SIC
4	14	Ex of Body Parts - DIE	24	27	Ex of Direct Object - RIE
5	30	Id of Declaratives - SIC	25	26	Ex of Subject - RIE
6	29	Id of Imperatives - SIC	26	11	Id of Categories - DIC
7	6	Id of Adjective+Noun - DIC	27	21	Ex of Negations - DIE
8	15	Ex of Number of Nouns - DIE	28	28	Ex of Indirect Object - RIE
9	5	Id of Adjectives - DIC	29	18	Ex of Adjectives - DIE
10	7	Id of N+Rel.Clause - DIC	30	24	Id of Direct Object - RIC
11	8	Id of Prepositions - DIC	31	12	Id of Negations - DIC
12	10	Id of Number of Nouns - DIC	32	19	Ex of Categories - DIE
13	23	Id of Subject - RIC	33	9	Id of Adverbs - DIC
14	3	Id of Verbs - DIC	34	25	Id of Indirect Object - RIC
15	22	Ex of Prepositions - DIE	35	17	Ex of Time - DIE
16	16	Ex of Verbs - DIE	36	33	Ex of Imperatives - SIE
17	36	Id of Topic - CIC	37	34	Ex of Interrogatives,- SIE
18	35	Id of Given/New - CIC	38	20	Ex of Adverbs - DIE
19	32	Ex of Declaratives - SIE	39	39	Ex of Focus - CIE
20	4	Id of Time - DIC			

KEY

DI - Denotational Information; RI - Relational Information; SI - Sentential Information.
CI - Contextual Information; Id- Identification; Ex- Expression.

denotational tasks form the basic level of the information categories.

As shown in Figure 1, there is a gradual jump in the ranks for tasks involving expression, i.e., expression of categories, tense, imperatives, interrogatives, adverbs and focus. Two identification tasks are also included here. These are the identification of adverbs and indirect objects. In order to determine the significant differences among ranks obtained for different tasks the Wilcoxon-Sign Rank Test (Siegel, 1956) was done. Table 6 gives the level of significance of the Wilcoxon-Sign Test using approximate between ranks that formed steps in the plot seen in Figure 1 (steps are given by ranks in Table 5 - 1,6,9,14,19,32,33,34,35,36,37,38 & 39). Significant differences between several tasks support the hypothesis that individual test items under each information level are different from each other, as they elicit different levels of information. Rank and task No. 39, relating to the expression of focus, is significantly different from all other ranks.

5.1.4 Summary of the results for normal group

The results with thirty normal subjects reveal that they obtain scores ranging from 93% to 100% on comprehension and 88% to 100% on expression tests. The independent variables do not seem to have any significant effect on the performance. The ranking data as given by normals account

TABLE 6

Level of Significance of Wilcoxon Signed Rank Test for Ranks

Rank No.	Task No.	1	6	9	14	19	32	33	34	35	36	37	38	39
		1	29	5	3	32	19	9	25	17	33	34	20	39
1	1	-	0.0809	0.0013*	0.0004*	0.0001*	0.0000*	0.0000*	0.0000*	0.0000*	0.0000*	0.0000*	0.0000*	0.0000*
6	29	-	-	0.0879	0.0475*	0.0001*	0.0002*	0.0001*	0.0001*	0.0000*	0.0000*	0.0072*	0.0000*	0.0297*
9	5	-	-	-	0.4603	0.0218*	0.0030*	0.0000*	0.0002*	0.0001*	0.0002*	0.0001*	0.0000*	0.0000*
14	3	-	-	-	-	0.0646	0.0192*	0.0004*	0.0012*	0.0003*	0.0022*	0.0011*	0.0000*	0.0000*
19	32	-	-	-	-	-	0.6275	0.0559	0.0450*	0.0416*	0.0099*	0.0035*	0.0001*	0.0000*
32	19	-	-	-	-	-	-	0.0351*	0.1307	0.0735	0.0311*	0.0030*	0.0000*	0.0000*
33	9	-	-	-	-	-	-	-	0.9871	0.7366	0.5098	0.8589	0.0325*	0.0004*
34	25	-	-	-	-	-	-	-	-	0.9280	0.9357	0.6143	0.0071*	0.0001*
35	17	-	-	-	-	-	-	-	-	-	0.9393	0.4663	0.0007*	0.0001*
36	33	-	-	-	-	-	-	-	-	-	-	0.1823	0.0043*	0.0000*
37	34	-	-	-	-	-	-	-	-	-	-	-	0.0056*	0.0000*
38	20	-	-	-	-	-	-	-	-	-	-	-	-	0.0297*
39	39	-	-	-	-	-	-	-	-	-	-	-	-	-

for the content validity as it reveals a significant difference among ranks.

5.2 PLTA scores with BDNA subjects

The test scores obtained with thirty brain-damaged nonaphasic (BDNA) subjects together with their means and standard deviations are given in Table 7. Here the mean for the overall comprehension score is 130.97 and the mean for the overall expression score is 127.77. The smallest value obtained for comprehension and expression are 124.00 (93.94%) and 111.00 (84.10%) respectively. This score was obtained by a chronic, brain-damaged male patient institutionalized for a long time at the Alberta Hospital, Ponoka. His scores form the outliers in this category. It is possible that for him the tasks especially related to sentential information on the expression side might have seemed artificial. In fact, out of the 16 institutionalized patients, 12 obtained low scores on expression tasks (mainly on sentential information, i.e., interrogatives and imperatives), accounting for a mean value of 127.77 (96.78%). However, the maximum scores obtained by BDNA subjects equal 100% (132) both on comprehension and expression. In summary, the BDNA responses range from 93.94% to 100% on the comprehension tasks and from 84.10% (a real

TABLE 7

PLTA Scores for BDNA Subjects

Variable Name	Total Freq.	Mean	S.D	Smallest Value	Smallest %Score	Largest Value	Largest %Score
Comp. Score	30	130.97	2.00	124.00	93.94	132.00	100
Exp. Score	30	127.77	6.86	111.00	84.10	132.00	100

outlier)[21] to 100% on the expression tasks.

In order to investigate the difference in performance depending on sex, age, education, languages known, etiology (MVA, CVA, 'Others'[22]) and onset (acute and chronic[23]) of the BDNA patients, means and standard deviations were computed for each variable category. These values are given in Table 8. Here the means and standard deviations are computed for the overall comprehension expression scores. A superficial examination of the means and standard deviation values reveal no significant difference among the six variable categories. T tests for the significant difference between means were not computed since the 'N' under each variable category seemed too small. As the Table 8 shows, there is no significant difference in the performance of BDNA patients with respect to sex, age, educational attainment, language, etiology and onset.

5.2.1 Summary of the results with BDNA group

The results with BDNA subjects reveal that they obtain scores ranging from 94 % to 100% on comprehension tasks and from 84% to 100% on the expression tasks. The independent variables considered did not seem to have any significant effect on the performance.

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[21]A cluster of outliers are formed by the five institutionalized patients whose scores range from 84.10% to 86%.
[22]Referring to brain damage due to tumor, encephalopathies, etc.
[23]Those with symptoms of brain damage for more than a year.

TABLE 8

Means and Standard deviations for Variable Groups with BDNA Subjects

No.	Variables	Types	Sample Size	Comp.Score Mean	Comp.Score S.D.	Exp.Score Mean	Exp.Score S.D.
1	Sex	Female	8	131.50	1.41	126.88	7.08
		Male	22	130.77	2.18	128.09	6.92
2	Age	Young	10	131.90	0.32	129.60	5.80
		Middle	12	129.83	2.22	125.67	8.57
		Old	8	131.50	1.41	128.62	4.80
3	Education	Elementary	4	129.00	3.83	121.50	7.72
		High School	22	131.31	1.43	129.00	5.87
		University	4	131.00	2.00	127.25	9.50
4	Language	Monolingual	18	130.72	2.27	127.44	7.25
		Bilingual	12	131.33	1.56	128.25	6.52
5	Etiology	MVA	7	131.14	1.57	129.00	7.93
		CVA	9	132.00	0.00	129.44	4.71
		Others	14	130.21	2.55	126.07	7.50
6	Onset	Chronic	17	130.24	2.44	126.24	8.16
		Acute	13	131.92	0.28	129.77	4.16

5.3 PLTA scores with BDA subjects

The test scores obtained with thirty brain-damaged aphasic (BDA) subjects together with their means and standard deviations are given in Table 9. Here the mean for the overall comprehension score is 99.63 (75.48%) and for the overall expression score is 61.63 (46.69%). The standard deviation for the comprehension score is 36.10 and for expression score is 46.75. The high S.D. values indicate greater variance among the scores and they also account for the spread of scores. The smallest value of 5.00 (3.79%) on the comprehension side and 0.00 on the expression side indicate the level of performance by some of the subjects in this group. However, the maximum response for comprehension is 100% and for expression is 95.45%. These values are important as they indicate a difference in the performance on comprehension and expression tasks among aphasics as a single group, when the individual subjects' responses are averaged regardless of their scores at each information level.

To understand the spread of scores as given by the S.D. values, means and standard deviations were computed for the different independent variable categories, namely, age, sex, educational attainment, languages known, onset and etiology. Table 10 clearly illustrates a large difference in mean values and consequent high standard deviations for all the six independent variable categories. To study the differences in means among the variables where the N was

TABLE 9

PLTA Scores for BDA Subjects

Variable Name	Total Freq.	Mean	S.D	Smallest Value	Smallest %Score	Largest Value	Largest %Score
Comp.Score	30	99.63	36.09	5.00	3.79	132	100.00
Exp. Score	30	61.63	46.75	0.00	0.00	126	95.45

TABLE 10

Means and Standard Deviations for Variable Groups with BDA Subjects

No.	Variables	Types	Sample Size	Comp.Score Mean	Comp.Score S.D.	Exp.Score Mean	Exp.Score S.D.
1	Sex	Female	10	102.50	35.27	72.40	48.09
		Male	20	98.20	37.32	56.25	46.36
2	Age	Young	9	112.56	40.83	86.00	48.44
		Middle	4	122.25	7.97	106.25	14.45
		Old	17	87.47	33.71	38.24	36.54
3	Education	Elementary	11	74.54	43.21	34.82	43.29
		High School	12	111.92	23.19	69.25	46.12
		University	7	118.00	18.73	90.71	33.47
4	Language	Monolingual	16	98.75	36.94	51.19	48.43
		Bilingual	14	100.64	36.47	73.57	43.38
5	Etiology	MVA	4	128.50	2.52	116.25	7.93
		CVA	19	95.79	35.73	55.74	43.25
		Others	7	93.57	42.65	46.43	50.52
6	Onset	Chronic	14	95.07	41.01	62.50	44.93
		Acute	16	103.62	32.01	60.87	49.75

large, t-tests were computed and their levels of significance are given in Table 11. In categories where the N is too small, for example four, the results of the t-tests may not be significant. On the comprehension side there is a difference between elementary and high school attainment ($t = 2.55$, $p \leq 0.022$) and elementary and university subjects ($t = 2.93$, $p \leq 0.011$). On the expression side there is a difference between young and old subjects ($t = 2.59$, $p \leq 0.022$). This is also evident from the S.D. values given in Table 10.

Here it is highly possible that all the independent categories interact among themselves and hence no variable can be thought to be highly significant in the performance of aphasic subjects. Such an interaction of different variables could not be studied here since the number of subjects was too small (30 aphasic subjects) for computing analysis of variance. However, age, education and etiology coupled with other variables seem to a have an effect on the overall scores obtained.

5.3.1 Percentage of gestural responses

Tables 12 and 13 gives the percentage of gestural responses produced by the aphasic subjects. These percentages are calculated with respect to the individual overall scores of 132 for comprehension and expression. On the comprehension side the percentage ranges from 1.74 (a score of 2 out of 115) to 77.78 (a score of 14 out of 18).

TABLE 11

T Scores for Different Variable Types with BDA Subjects

No.	Variables	Effects	N	Comp. Scores T Score	Comp. Scores P Value	df	Exp. Scores T Score	Exp. Scores P Value	df
1	Sex	F vs M	10/20	0.31	0.761	19.1	0.88	0.392	17.5
2	Age	Y vs M	9/ 4						
		Y vs O	9/17	1.58	0.137	13.9	2.59	0.022*	13.0
		M vs O	4/17						
3	Education	E vs H	11/12	-2.55	0.022*	15.0	-1.85	0.079	21.0
		E vs U	11/ 7	-2.93	0.011*	14.7	-3.07	0.008	15.2
		H vs U	12/ 7	-0.62	0.542	15.0	-1.17	0.260	16.0
4	Language	M vs B	16/14	-0.14	0.889	27.6	-1.34	0.193	28.0
5	Etiology	MV vs CV	4/19						
		MV vs OT	4/ 7						
		CV vs OT	19/ 7	0.12	0.905	9.3	0.43	0.675	9.4
6	Onset	C vs A	14/16	-0.63	0.534	24.5	0.09	0.926	28.0

TABLE 12

Percentage of Gestural Responses by BDA Subjects for Comprehension Tasks

No.	Overall Comp. Score	Gestural Response Score	Gestural Response Percent*	No.	Overall Comp. Score	Gestural Response Score	Gestural Response Percent*
1	110	16	14.55	16	130	0	0.00
2	5	0	0.00	17	104	4	3.85
3	127	4	3.15	18	81	14	17.28
4	128	0	0.00	19	83	14	16.87
5	69	2	2.90	20	91	10	10.99
6	60	20	33.33	21	116	4	3.45
7	55	6	10.91	22	132	0	0.00
8	71	6	8.45	23	121	0	0.00
9	126	0	0.00	24	109	8	7.34
10	88	6	6.82	25	33	0	0.00
11	18	14	77.78	26	120	6	5.00
12	128	0	0.00	27	127	0	0.00
13	122	4	3.28	28	115	2	1.74
14	132	0	0.00	29	131	0	0.00
15	131	0	0.00	30	126	0	0.00

*The percentages are calculated with respect to the individual overall scores.

TABLE 13

Percentage of Gestural Responses by BDA Subjects for Expression Tasks

No.	Overall Exp. Score	Gestural Score	Response Percent*	No.	Overall Exp. Score	Gestural Score	Response Percent*
1	0	0	0.00	16	112	0	0.00
2	4	0	0.00	17	59	4	6.78
3	96	0	0.00	18	31	14	45.16
4	119	8	6.72	19	57	12	21.05
5	56	22	39.29	20	0	0	0.00
6	37	36	97.28	21	95	8	8.42
7	2	0	0.00	22	126	2	1.59
8	32	6	18.75	23	62	16	25.81
9	112	0	0.00	24	37	30	81.08
10	14	8	57.14	25	2	2	100.00
11	5	2	40.00	26	4	4	100.00
12	108	6	5.56	27	115	6	5.22
13	19	18	94.74	28	93	12	12.90
14	121	4	3.31	29	108	2	1.85
15	122	0	0.00	30	101	10	9.90

* The percentages are calculated with respect to the individual overall scores.

This indicates the ability of some subjects to respond to gestures, which are a mode of communication. On the expression side percentage of gestural responses range from 1.59% (a score of 2 out of 126) to 97% (a score of 36 out of 37). Here the 100% gestural responses obtained by subjects No. 25 and 26 are considered not very important since their overall scores happen to be very low; these were the most severe expressive cases, but they apparently retained good comprehension. However, a greater percentage of gestural responses are indicated for the expression scores, which suggests that many aphasics may retain the cognitive (meaning) component of communication but lose only the verbal tools to express those ideas. It is also clear from Tables 12 and 13 that subjects (no. 13, 24, 6, 18) with good comprehension scores also use a good percentage of gestural responses on the expression side. Thus gesture seems to be an important mode of communication when verbal tools are lost, as evidenced by its use by subjects with good comprehension but poor expression.

5.3.2 Summary of the results obtained with BDA subjects

The overall responses obtained by aphasics on the comprehension and expression tests reveal a wide range of scores with a mean value of 99.63 (75.48%) and 61.63 (44.69%) respectively. Several independent factors such as sex, age, education, onset and etiology seem to significantly interact on the performance of the test. A

large percentage of gestural responses are obtained for expression tasks from subjects having good comprehension but poor expression.

5.4 Group comparisons: normal, BDNA & BDA

5.4.1 Overall scores

A visual comparision of the overall scores for comprehension and expression among the three groups viz., normal, brain-damaged nonaphasic and brain-damaged aphasic subjects is shown in in Figures 2 and 3, which indicate that the BDA scores are far below the normal and BDNA scores. Some subjects in the BDNA group form outliers and this has already been explained in section 5.1.2. Among the BDA subjects, some obtain as good scores as the normals on the comprehension side. These are the subjects who have shown good spontaneous recovery aided by speech therapy. However, these patients have other problems which relate to reading and calculation, and about which no information is elicited on this test.

5.4.2 Tukey tests

The means for overall comprehension scores and expression scores among the three groups were compared by using the Tukey tests. Table 14 summarizes the results of Tukey tests obtained for six different means (The

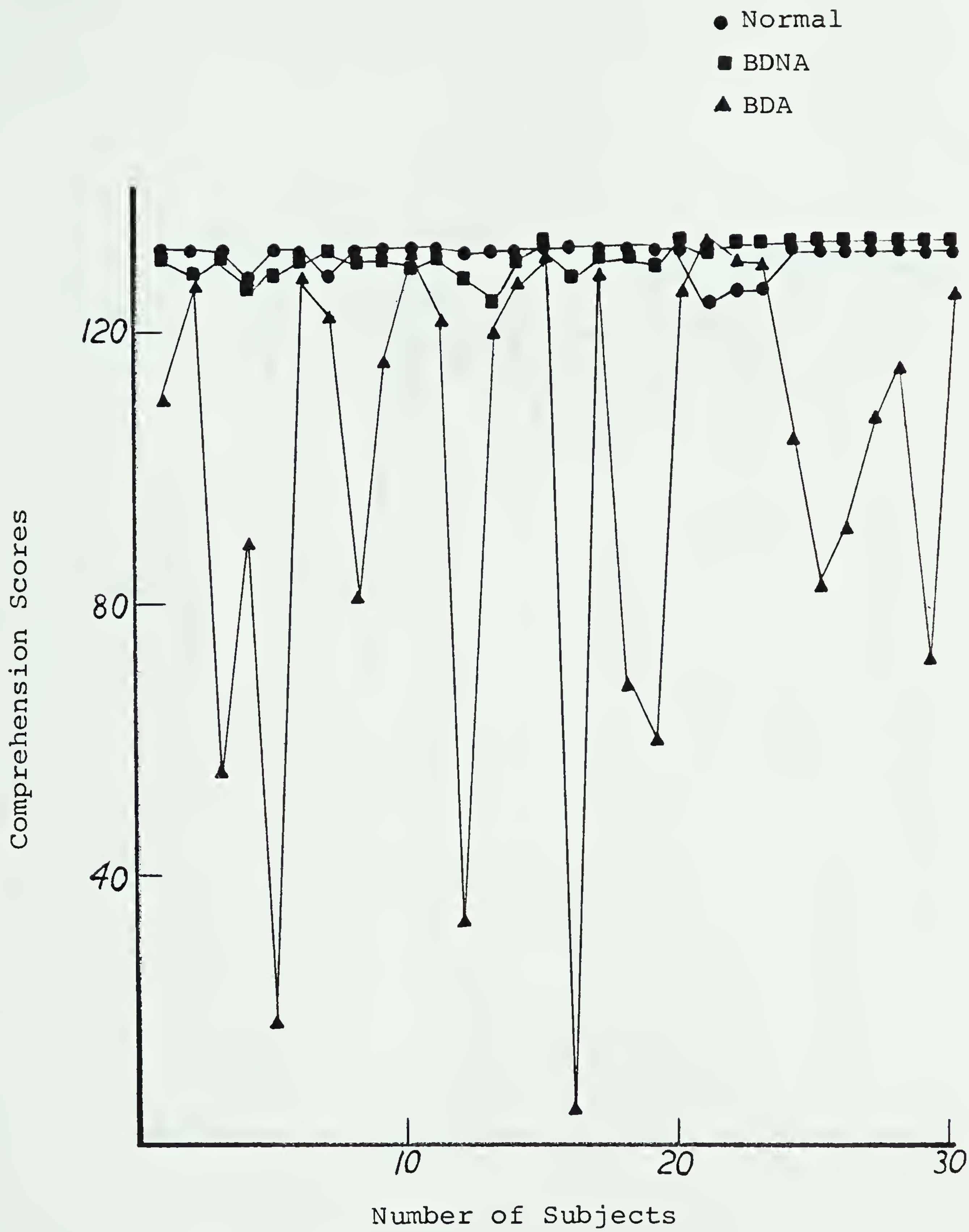

Figure 2. Plot of Overall Comprehension Scores

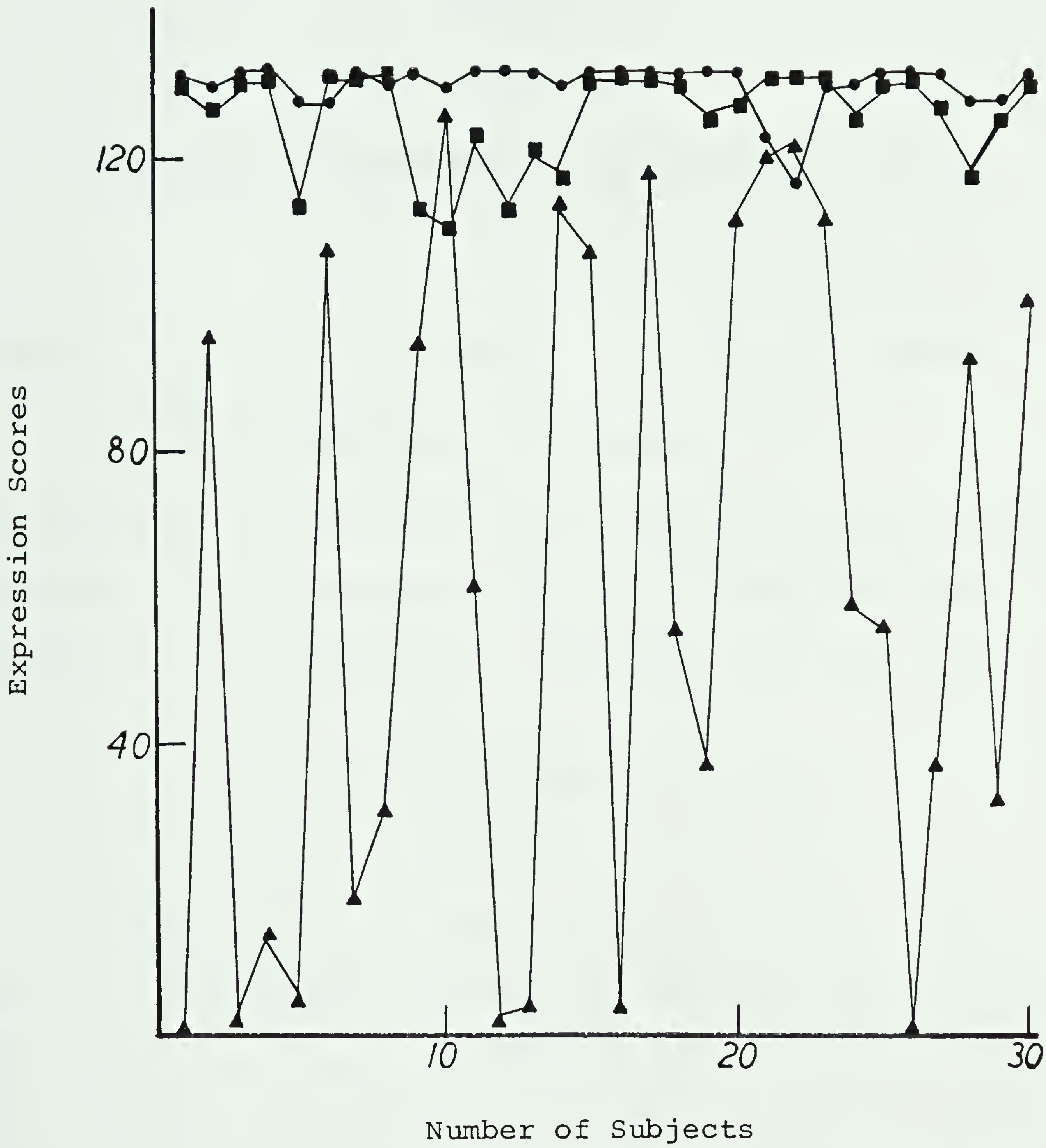

Figure 3. Plot of Overall Expression Scores

TABLE 14

Tukey Tests for Comprehension and Expression Scores

Groups	Means		Summary
	Comp. Score	Exp. Score	
Normal(G1)	131.07(T1)	130.27(T2)	G1 & G2 = not Sig.
BDNA(G2)	130.90(T3)	127.17(T4)	G1 & G3 = ***
BDA(G3)	99.57(T5)	61.63(T6)	G2 & G3 = ***

Q Values

	T6	T5	T4	T2	T3	T1
T6		15.21**	26.28**	27.52**	27.78**	27.84**
T5			11.07**	12.31**	12.56**	12.63**
T4				1.24	1.49	1.56
T2					0.25	0.32
T3						0.07
T1						

comprehension and expression means for normal, BDNA and BDA groups). A table of Q values given in Table 14, shows the significant differences between means which exceed the criterion value of Q. From these Q values it is clear that there is a significant difference between T6 (expression mean for BDA) and all other means including the BDA comprehension mean (T5). The BDA comprehension mean is highly different from all other means of the two other groups. There is no significant difference between normal and BDNA groups in terms of their overall comprehension and expression means. The means for overall comprehension and expression scores are significantly different from the normal and BDA groups. (Q values of 27.85 for T1 & T6; 27.53 for T5 & T2; 12.63 for T5 & T2 and 12.31 for T5 & T1 illustrate this clearly.) The means for overall comprehension and expression scores are significantly different from BDNA and BDA groups. (Q values of 27.78 for T3 & T6; 26.28 for T4 & T6; 12.57 for T5 & T3; and 11.07 for T4 & T5 illustrate this clearly.)

The important fact that emerges from this comparison relates to the significant difference between comprehension and expression means for the BDA group. (Q value of 15.21 for T6 & T5.) The test is sensitive enough to separate the performance on comprehension and expression tasks. The results support the hypothesis stated in Chapter One that there is no difference in the perfomance of normals and brain-damaged nonaphasics; but there is a difference in the

performance of normals and BDA subjects, and BDNA and BDA subjects. There is no significant difference between comprehension scores for normals and BDNA subjects. (Q values of 0.32 for T1 & T2;and 1.50 for T3 & T4 illustrate this clearly.)

5.4.3 Means and Standard deviations at different information levels

The performance of normal, BDNA and BDA subjects were compared at different informational levels viz., denotational, relational, sentential and contextual on comprehension and expression tasks. The scores on three control tasks were also included here. The means and standard deviations given in Table 15 for different tasks may be compared. Here the taks are: denotational comprehension (DIC), denotational expression (DIE), sentential comprehension (SIC), sentential expression (SIE), relational comprehension (RIC), relational expression (RIE), contextual comprehension (CIC), contextual expression (CIE), control comprehension (CON 1), and control expression (CON 2 & CON 3). The means for the BDA group seem to be different for the levels as compared with the other two groups. The S.D. values also differ significantly for the BDA group. Higher S.D. values for BDA group in all the 11 tasks indicate greater variance and spread of scores. This is also clear when we compare the means with the maximum score values possible at each level. BDA group subjects in general

TABLE 15

Group Means and Standard Deviations at Different Information Levels

Information Levels	Max. Scores	Normal Mean	Normal S.D	BDNA Mean	BDNA S.D	BDA Mean	BDA % Score	BDA S.D
DIC	84	83.93	0.37	83.73	1.01	66.43	79.08	22.33
DIE	78	77.43	1.28	77.27	1.61	41.40	53.08	28.29
RIC	9	8.47	1.38	8.47	1.38	6.03	67.00	3.63
RIE	9	9.00	0.00	8.90	0.54	4.23	47.00	5.10
SIC	30	29.93	0.36	30.00	0.00	22.10	73.66	9.54
SIE	30	29.00	2.08	26.13	6.23	9.73	32.43	9.87
CIC	6	6.00	0.00	5.90	0.40	3.53	58.83	2.33
CIE	9	9.00	0.00	8.80	0.80	4.00	44.44	3.65
CON 1	3	2.87	0.50	2.87	0.50	1.67	45.67	1.39
CON 2	3	2.83	0.53	2.70	0.70	1.13	37.66	1.27
CON 3	3	3.00	0.00	2.90	0.40	1.10	36.67	1.29

show difficulties at each level as compared with the other two groups.

The percentage scores given only for the BDA group show that aphasics as a group obtain better comprehension scores at all levels than at equivalent expression levels. Comprehension scores at the denotational level and at the sentential level seem to be better than the comprehension scores at other levels. However, the lowest percentage score is obtained at the sentential level of expression. It is noted that mean values for BDA group range from 32.43% (SIC level) to 79.08 (DIC) and this is highly different from other two groups (normal and BDNA) who obtain maximum scores at all levels. It seems clear that aphasics as a group perform better on comprehension tasks than expression tasks. Further discussion on the differences in information levels with comprehension and expression tasks for the BDA group specifically will be made in Chaper Six.

5.4.4 Discriminant Function Analysis

A linear Discriminant Function Analysis (DFA) was done on all the information level scores combined, i.e., for eleven different tasks (DIC,DIE,RIC,RIE,SIC,SIE,CIC,CIE,CON 1,CON 2, & CON 3). This DFA classifies data into groups according to functions based on variables. Here the functions were based on the comprehension and expression scores of the five different sections, viz., denotational, relational, sentential, contextual and control. The groups

into which the data are classified are the three subject categories namely, normal, BDNA and BDA.

The classification results are given in Table 16. The overall correct classification is 66.67% based on the two main functions which related to comprehension and expression. As Table 16 shows, group 1 (normal) and group 3 (BDA) are classified 76.7% correct of the time. In group 2 (BDNA), 50% of the subjects are classified as coming under group 1. The subjects with 100% scores are classified under group 1 category and subjects with 90-100% scores are classified in the BDNA category. It is indeed interesting to see three BDNA subjects categorized as aphasics since they obtained poorer scores on expression tasks. These are the institutionalized patients. Among the BDA subjects, one patient who indicated very good spontaneous recovery is classified as normal and this patient was being specially seen for therapy for improving reading and spelling skills. Six other subjects of the BDNA group were classified under BDA group. These subjects had good comprehension but mild problems[24] on the expression side.

Figure 4 shows the scatterplot diagram where * indicates the group centroid. The canonical discriminant function one (which highly correlates with DIC, DIE, SIE, RIE, CIC, CIE, and CON3) distinguishes group 3 from 1 and 2. Function two (which highly correlates with DIE, SIC, RIE,

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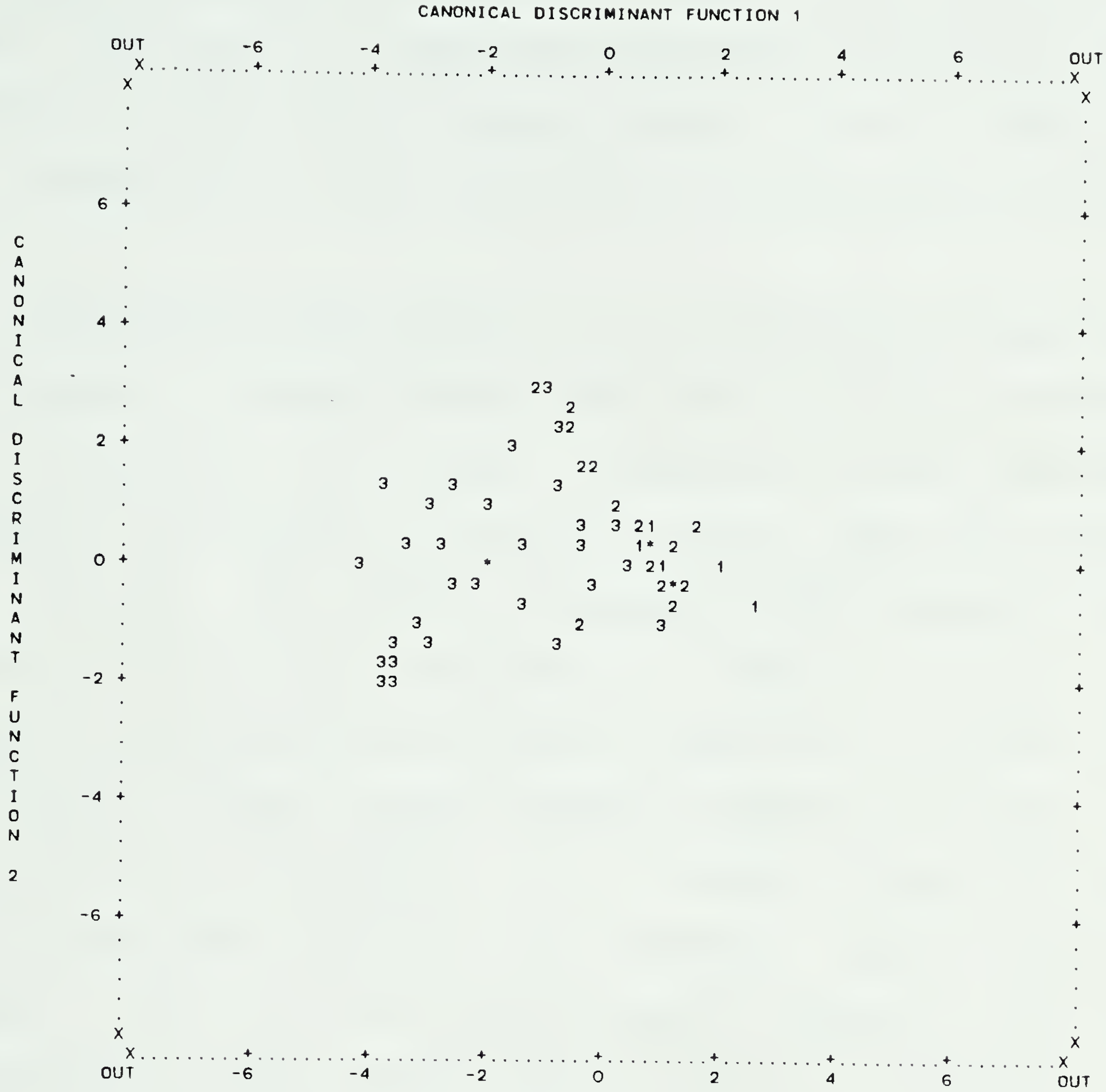
[24]These were evidently so mild as not to be noted clinically, but were picked up by the test.

TABLE 16

DFA Classification Results: 3 Groups

Actual Group		No. of Cases	Predicted Group Membership		
			1	2	3
Normal	1	30	23 76.7%	7 23.3%	0 0.0%
BDNA	2	30	15 50.0%	14 46.7%	1 3.3%
BDA	3	30	1 3.3%	6 20.0%	23 76.7%

Percent of 'grouped' cases correctly classified: 66.67%



* Group Centroid

Figure 4. All Groups Scatterplot of Discriminant Function Analysis

CIC, CON1, CON2 and CON3 i.e., primarily expression tasks) distinguishes group 2 from group 1 and 3. The plot also shows that group 3 is separated distinctly from group 1 and 2. There is some overlap between groups 1 and 2 (this is also reflected in the classification scores given in Table 16).

Since 50% of the subjects of group BDNA were classified under group 1, another DFA was done assuming the existence of two groups, i.e., group 1 (composed of normal and BDNA subjects, who perform in a similiar way as shown by Tukey test results) and group 2 (composed of BDA subjects). The results of this analysis are given in Table 17. Here the percent of grouped cases correctly classified is 92.22%. Out of 60 control group (normal and BDNA) subjects, only one is classified as an aphasic. He is a male, 79 years old, an institutionalized patient who obtained highly deviant scores. Out of the thirty aphasic subjects 80% are classified correctly and 20% (6) of them are classified as normals. These subjects had good comprehension but revealed mild expressive difficulties. Most of these patients were seen for therapy for writing and reading skills. Function one (which highly correlates with DIC, DIE, SIE, RIC, CIC, CIE, and CON3) distinguishes between group 1 and 2. Thus the DFA verifies the existence of two different groups and this is further illustrated by the histogram shown in Figure 5.

TABLE 17

DFA Classification Results: 2 Groups

Actual Group		No. of Cases	Predicted Group Membership	
			1	2
Normal	1	60	59	1
			98.3%	1.7%
BDA	2	30	6	24
			20.0%	80.00%

Percent of 'grouped' cases correctly classified: 92.22%

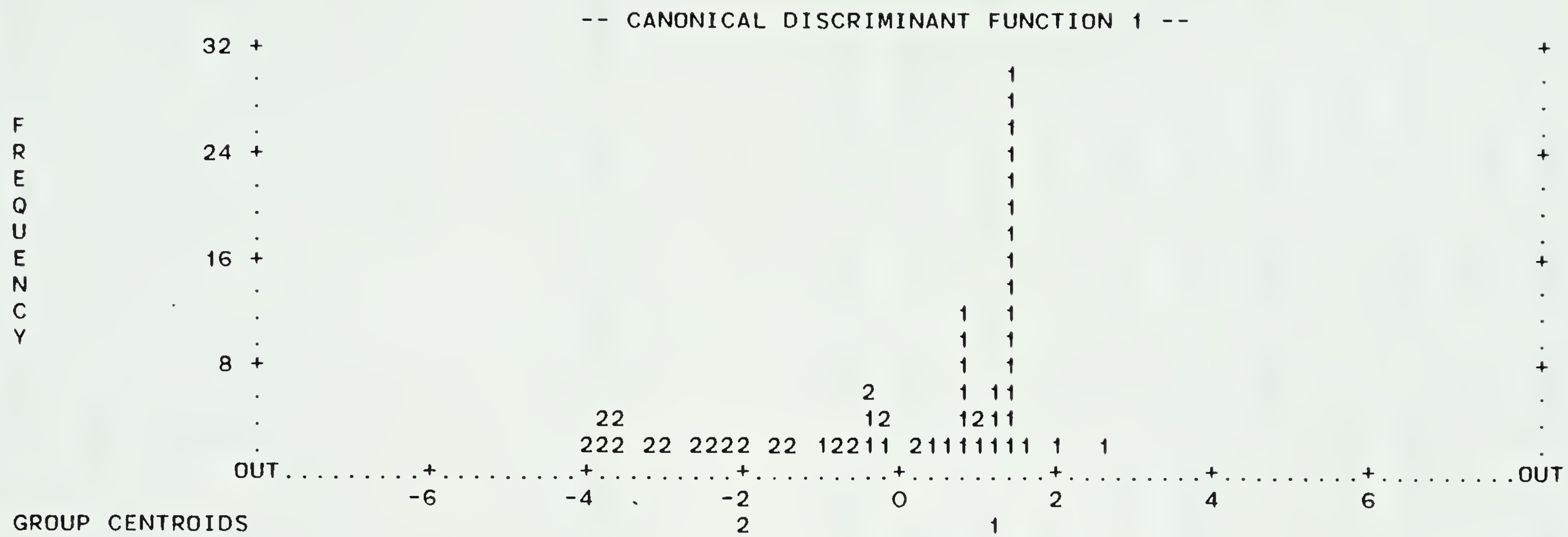


Figure 5. Histogram for the Canonical Discriminant Function

5.4.5 Summary of the results from group comparisons

Tukey test results for the overall expression and comprehension means among the three groups viz., normal, BDNA and BDA reveal that normals and nonaphasics perform on this test in the same way and this is significantly different from the aphasic subjects. The means and standard deviations computed for all the three groups at different task level reveal significant differences between aphasics and normals; aphasics and brain-damaged nonaphasics. The DFA supports the above results and a correct classification score of 92.22% given in Table 17 (when BDNA and normals are considered to perform in the same way) indicates the diagnostic power of the test. Thus, the aphasic group clearly is distinct from normal and brain-damaged nonaphasic groups.

5.5 Test scores and different types and degrees of aphasic disorder

5.5.1 Profile analysis

For purposes of understanding the performance of thirty aphasic subjects at different task levels, profiles were drawn for each subject and they were compared with each other in terms of their profile contours. This way the aphasic responses were not pooled together, since pooling of aphasic scores either across individuals or across subtests

causes a loss of information. The problem of overall scores in terms of average is one of the limitations with the tests available on aphasia (see Chapter Two). Figures 6 to 20 illustrate the profiles for thirty subjects drawn with respect to their raw scores given in Appendix G. Here the order of the test tasks were DIC, SIC, RIC, CIC, CO1 (all comprehension tasks) followed by DIE, SIE, RIE, CIE, CON 2 & CON3 (all expression tasks). The sentential tasks came after the denotational tasks since their scores formed the next highest order when compared with the possible test scores for each task. The normal contour is given by the line joining the maximum scores expected at each level as in Figures 6 to 20 and represents the maximum scores that could be obtained at each task level. Based on the profiles it was possible to describe the individual performance on different tasks viz, comprehension and expression and at different levels viz., denotational, sentential, relational and contextual. Here the profiles provide a visual picture of the individual test performace. Based on the description given by profiles (eg., moderate comprehension difficulties and severe expression difficulties for subject 20 as shown in Figure 14) the subjects were classed under seven categories. Table 18 gives the profile categories or types and Table 19 gives the group means[25] for comprehension and production tasks for the seven profile types.

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[25]Here the significant difference between means is not computed since the number of subjects under each profile type is very small.

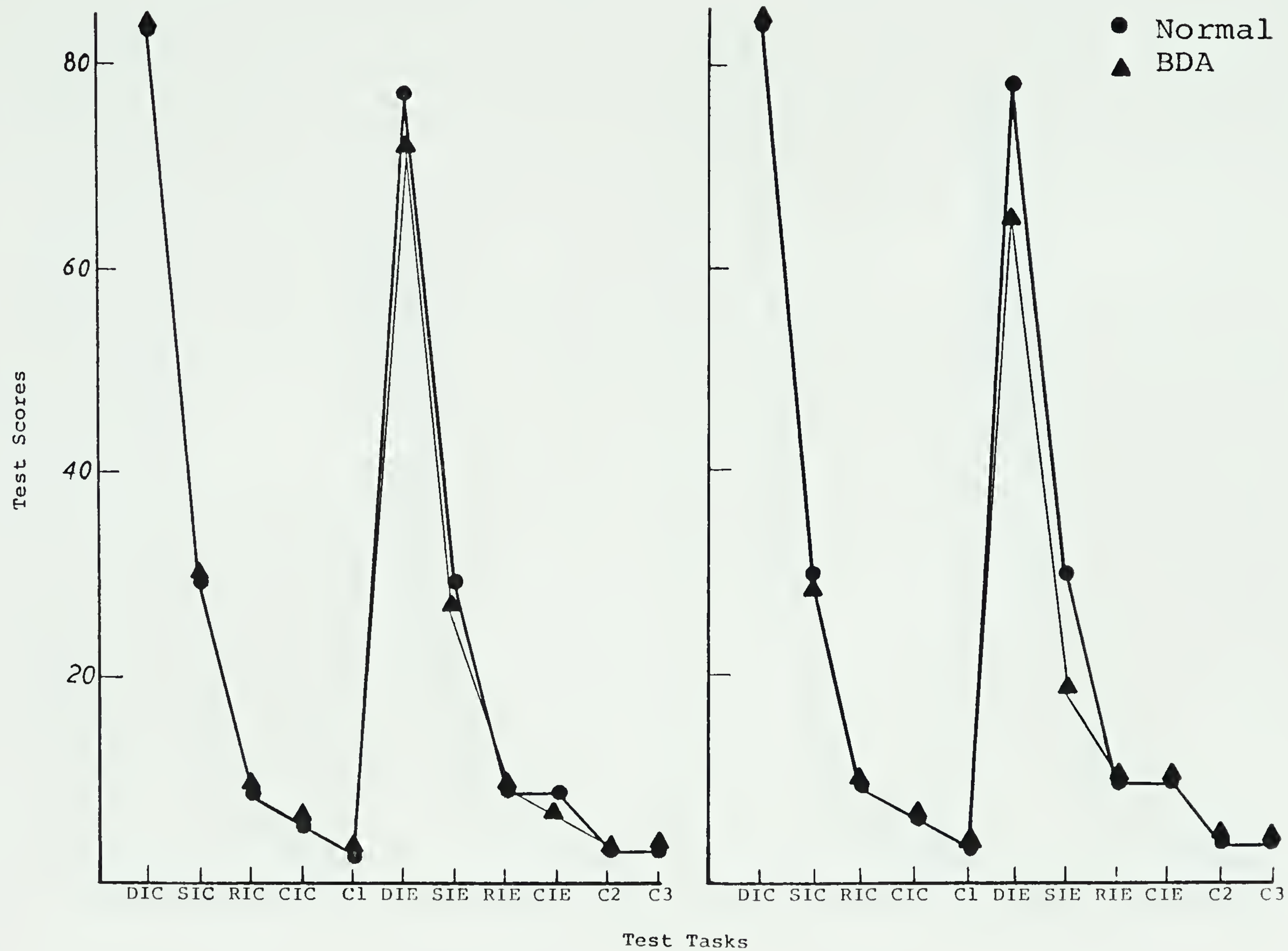


Figure 6. Profiles for Subjects 1 & 2

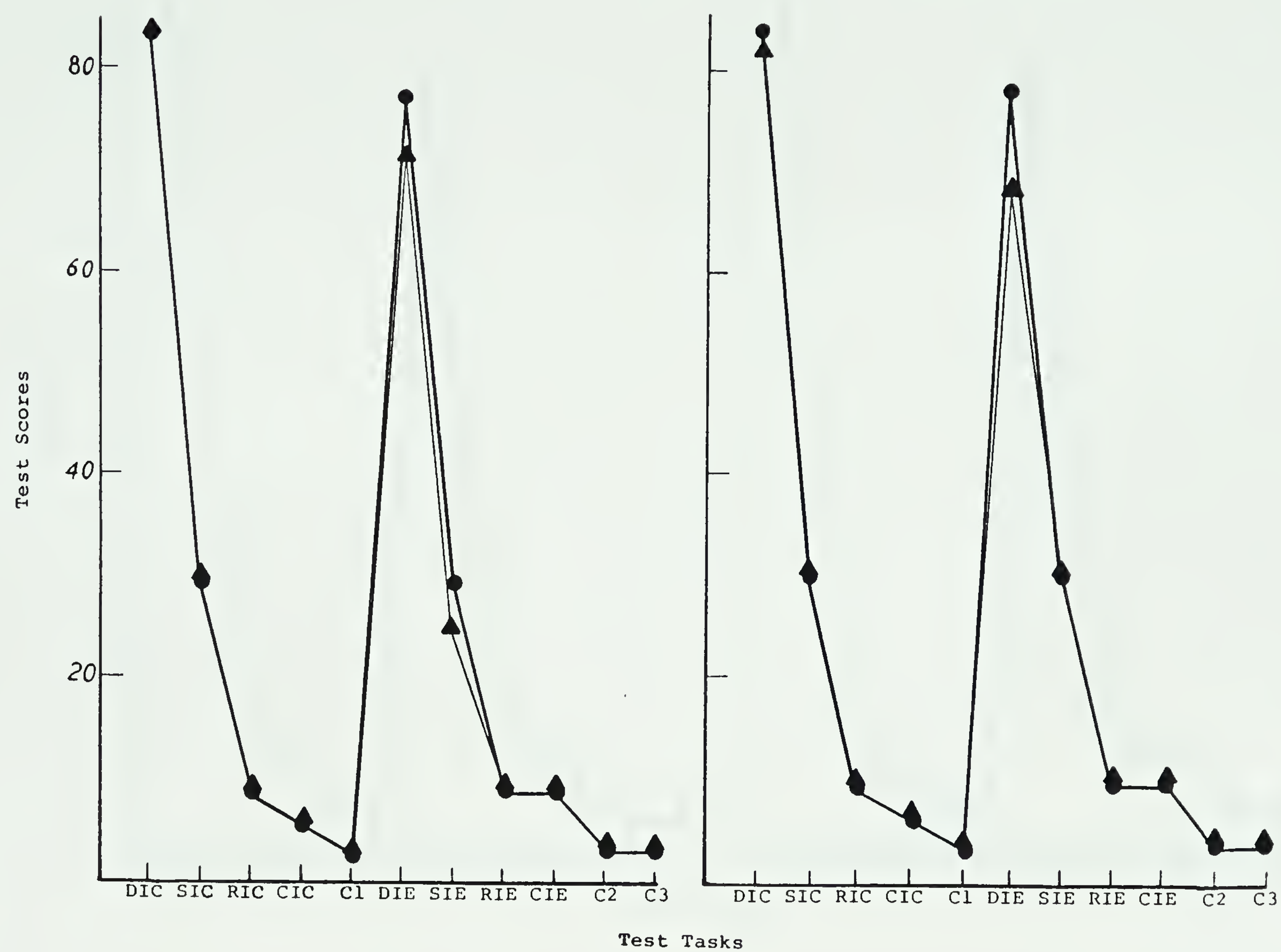


Figure 7. Profiles for Subjects 3 & 4

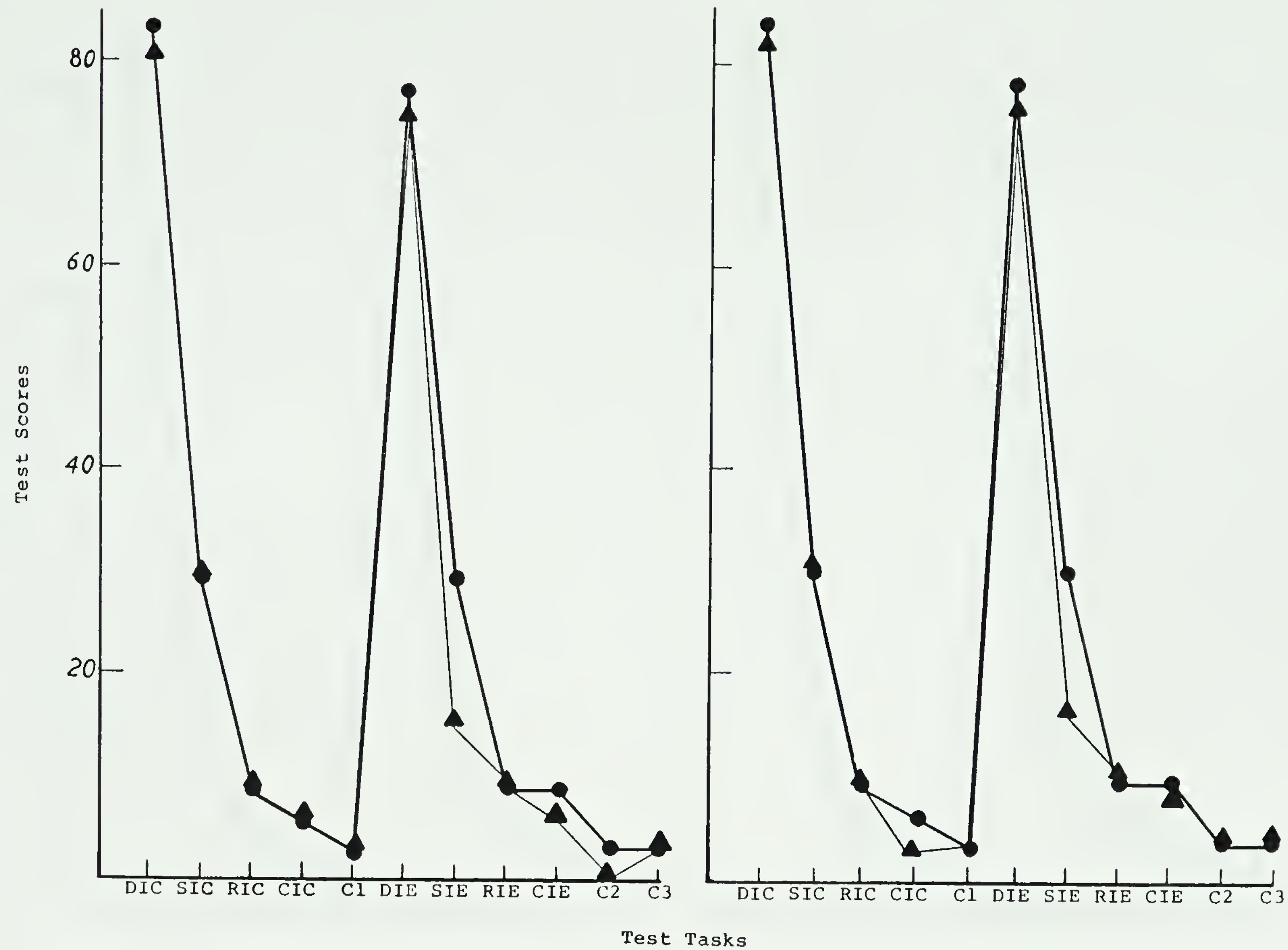


Figure 8. Profiles for Subjects 5 & 6

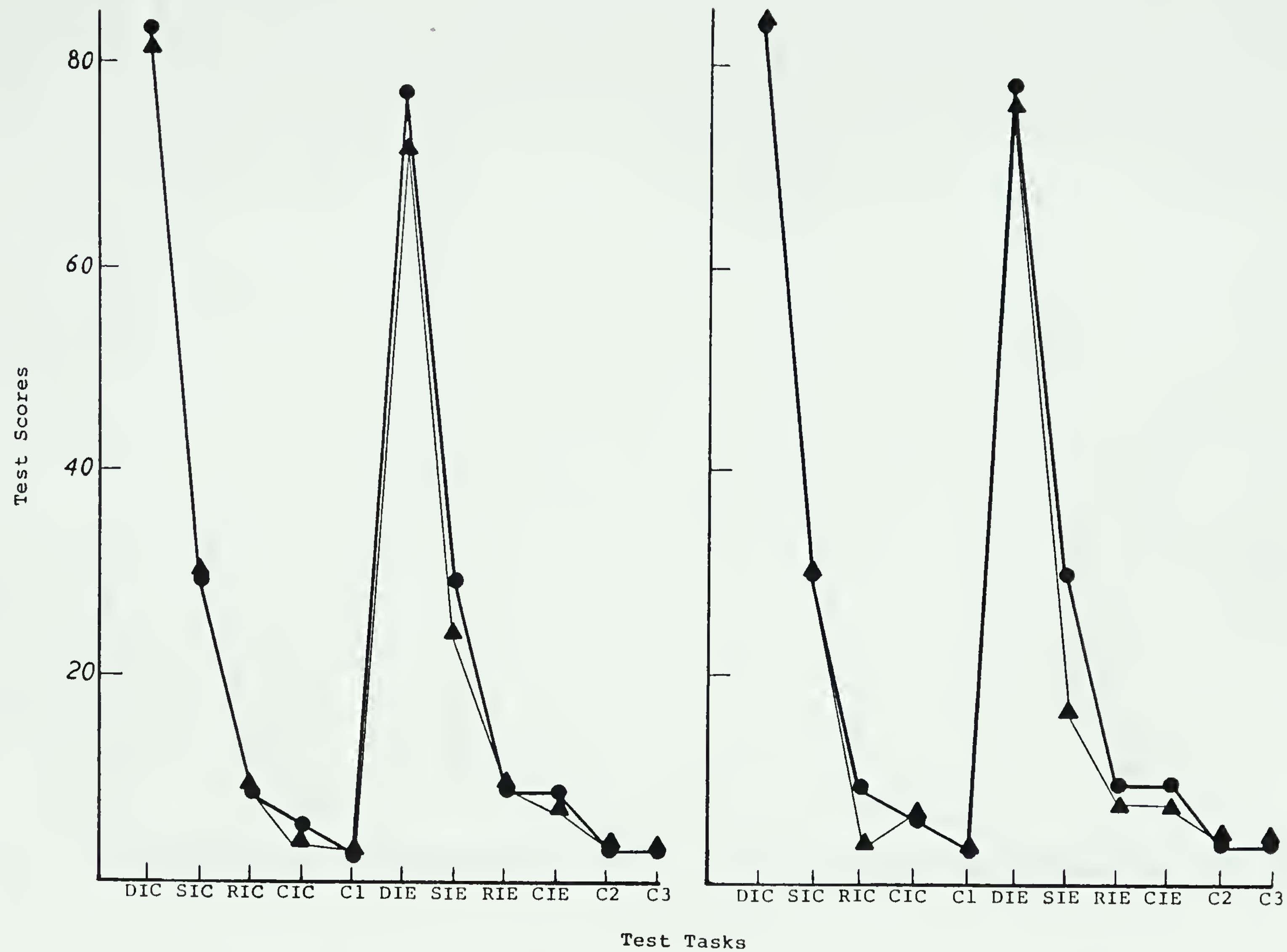


Figure 9. Profiles for Subjects 7 & 8

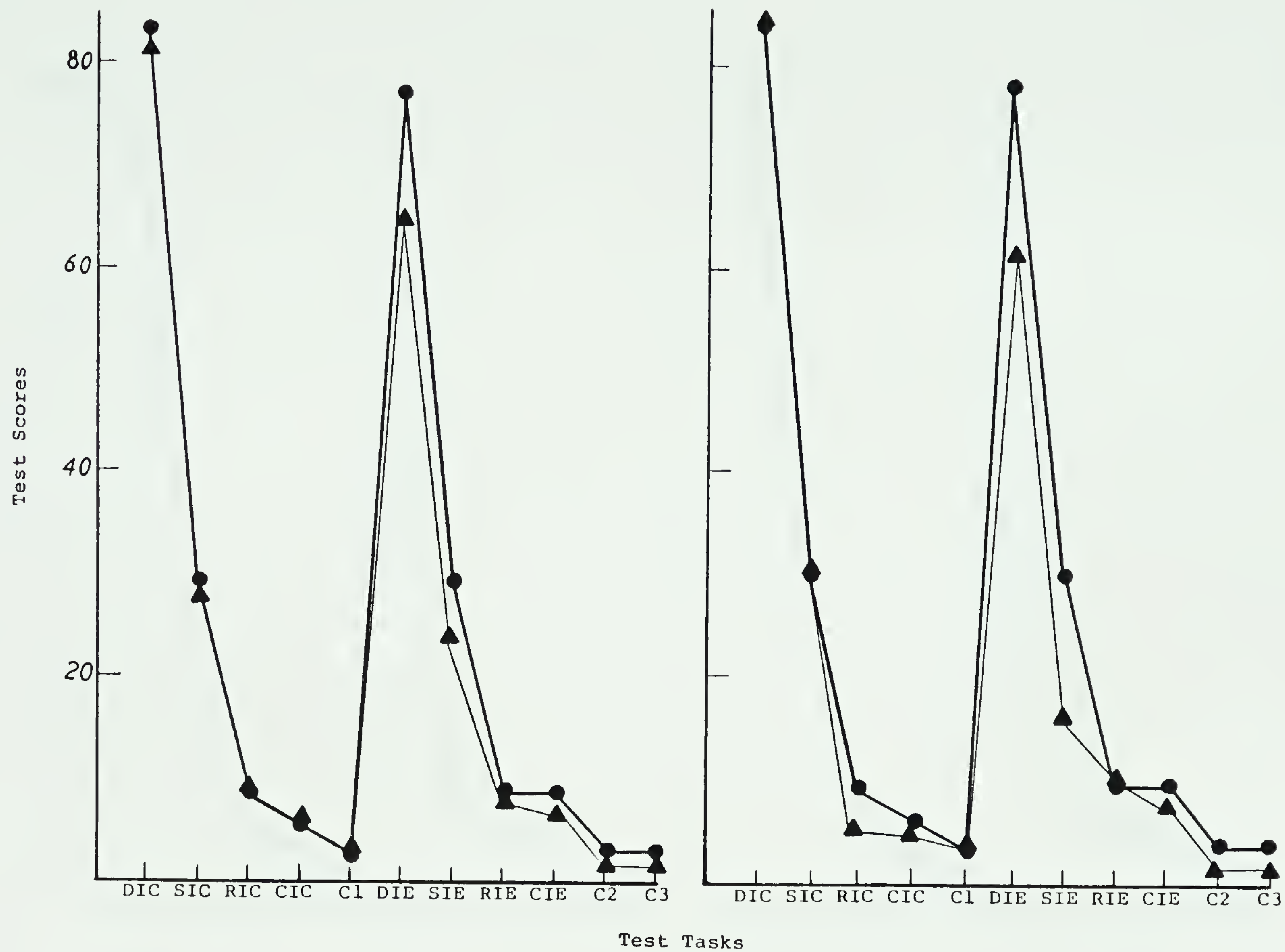


Figure 10. Profiles for Subjects 9 & 10

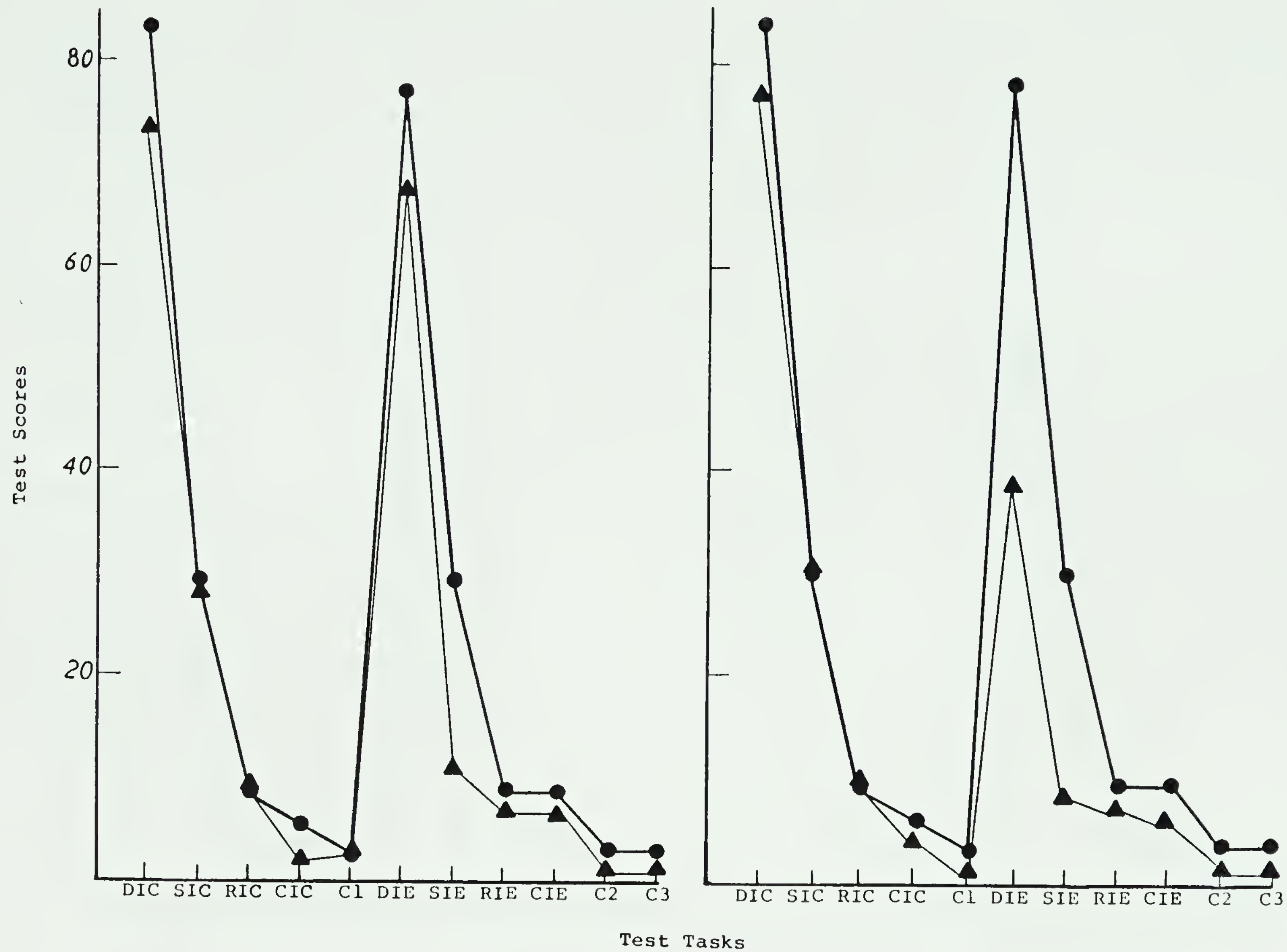


Figure 11. Profiles for Subjects 11 & 12

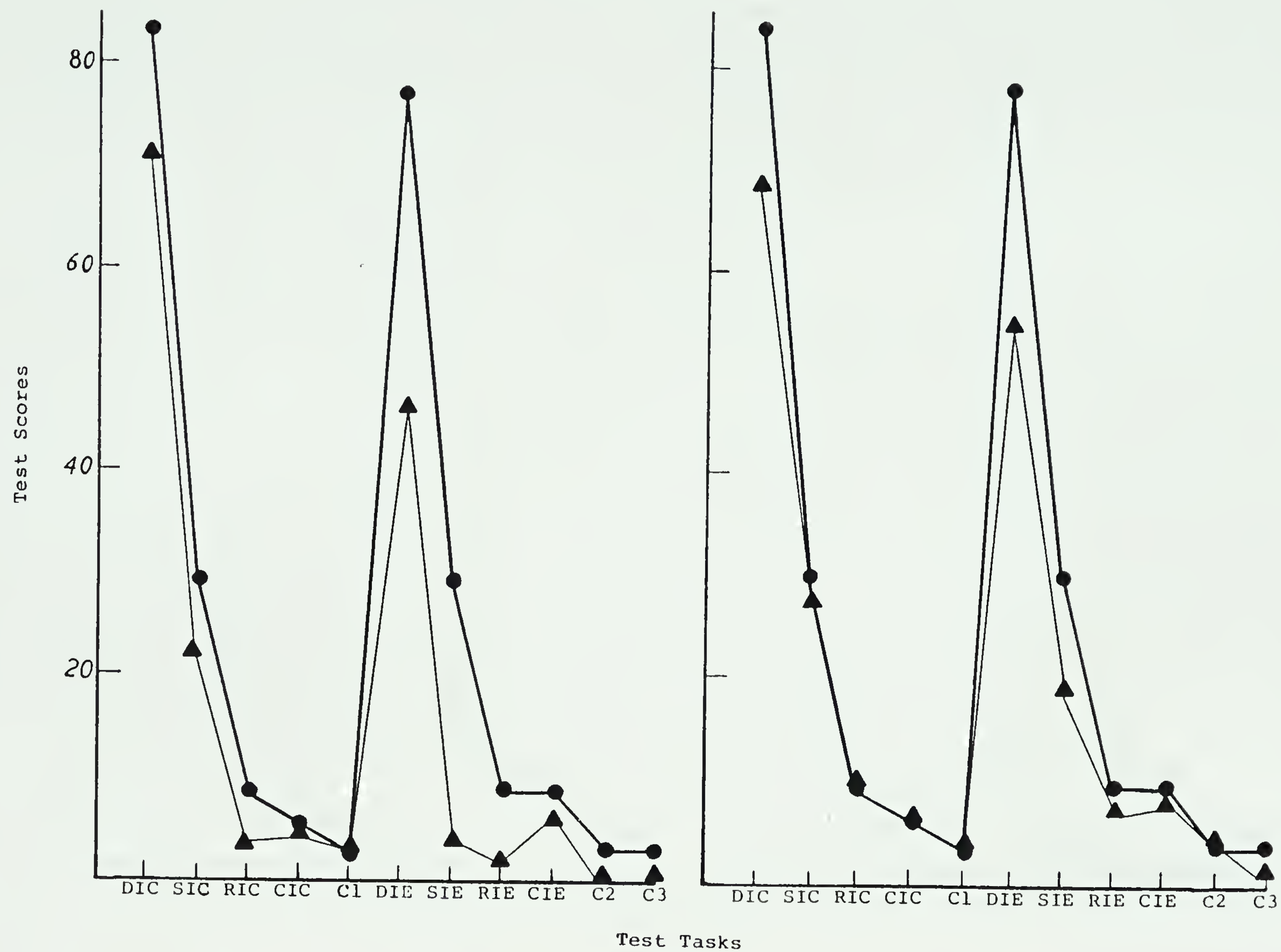


Figure 12. Profiles for Subjects 13 & 14

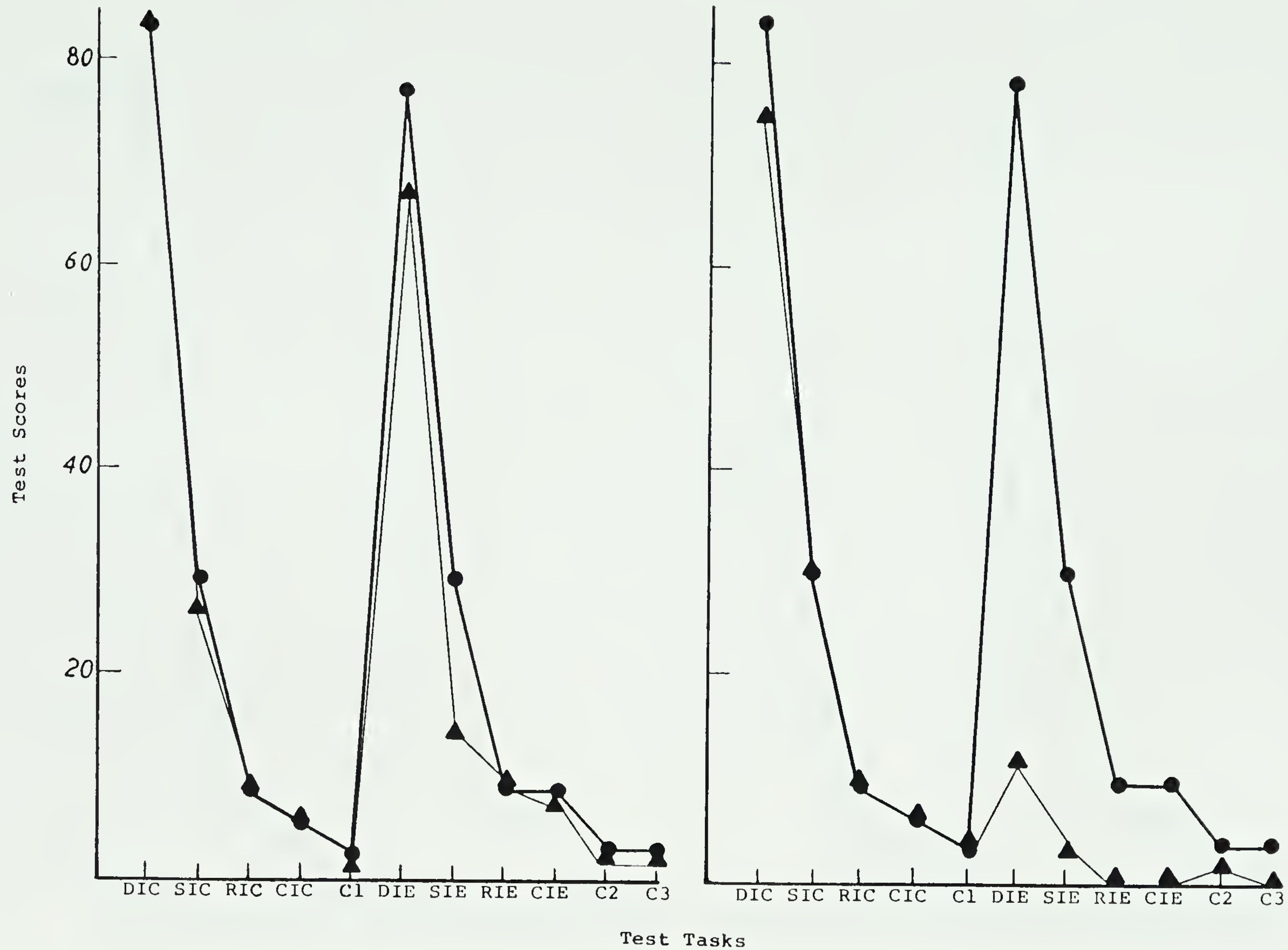


Figure 13. Profiles for Subjects 15 & 16

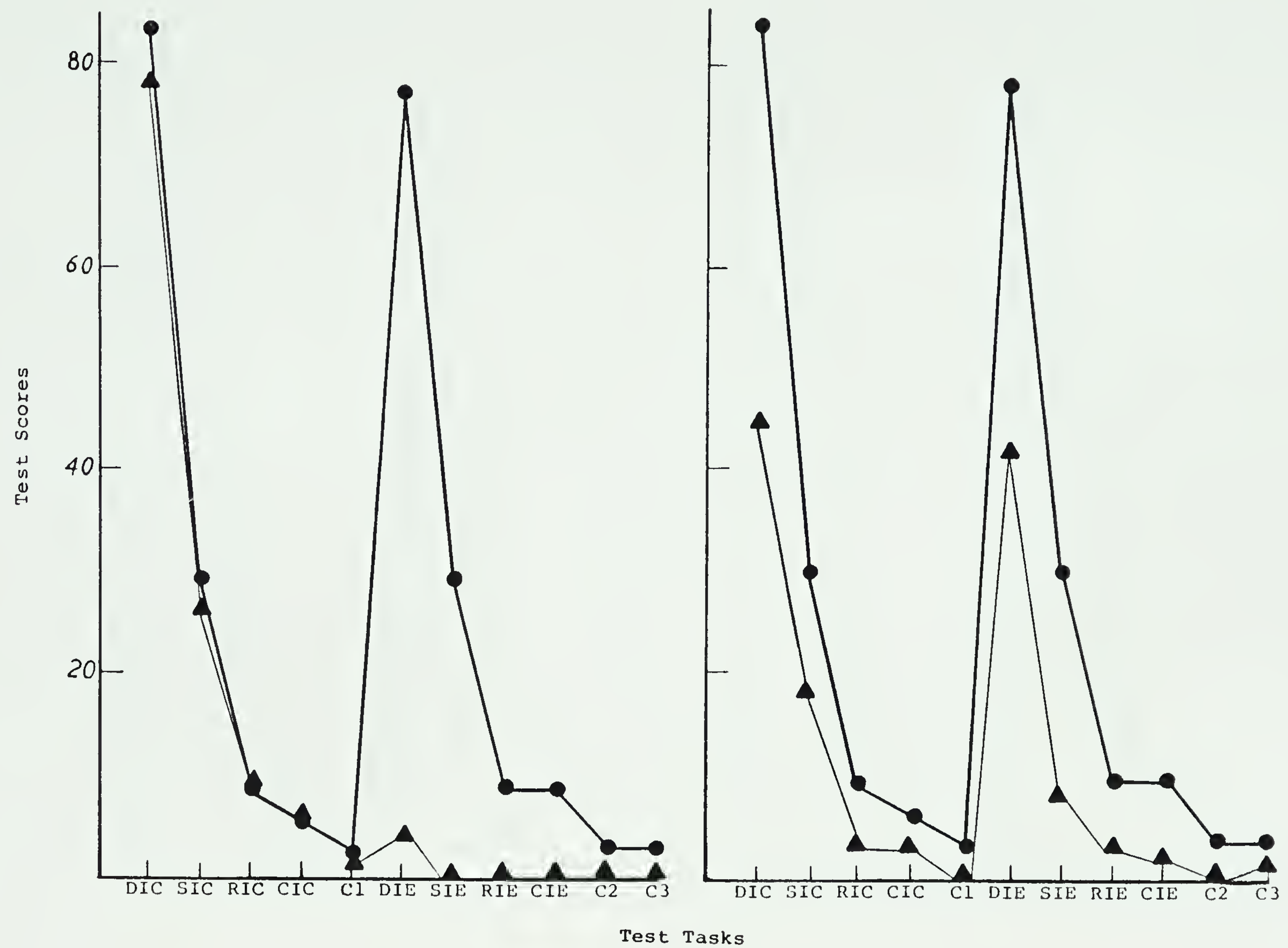


Figure 14. Profiles for Subjects 17 & 18

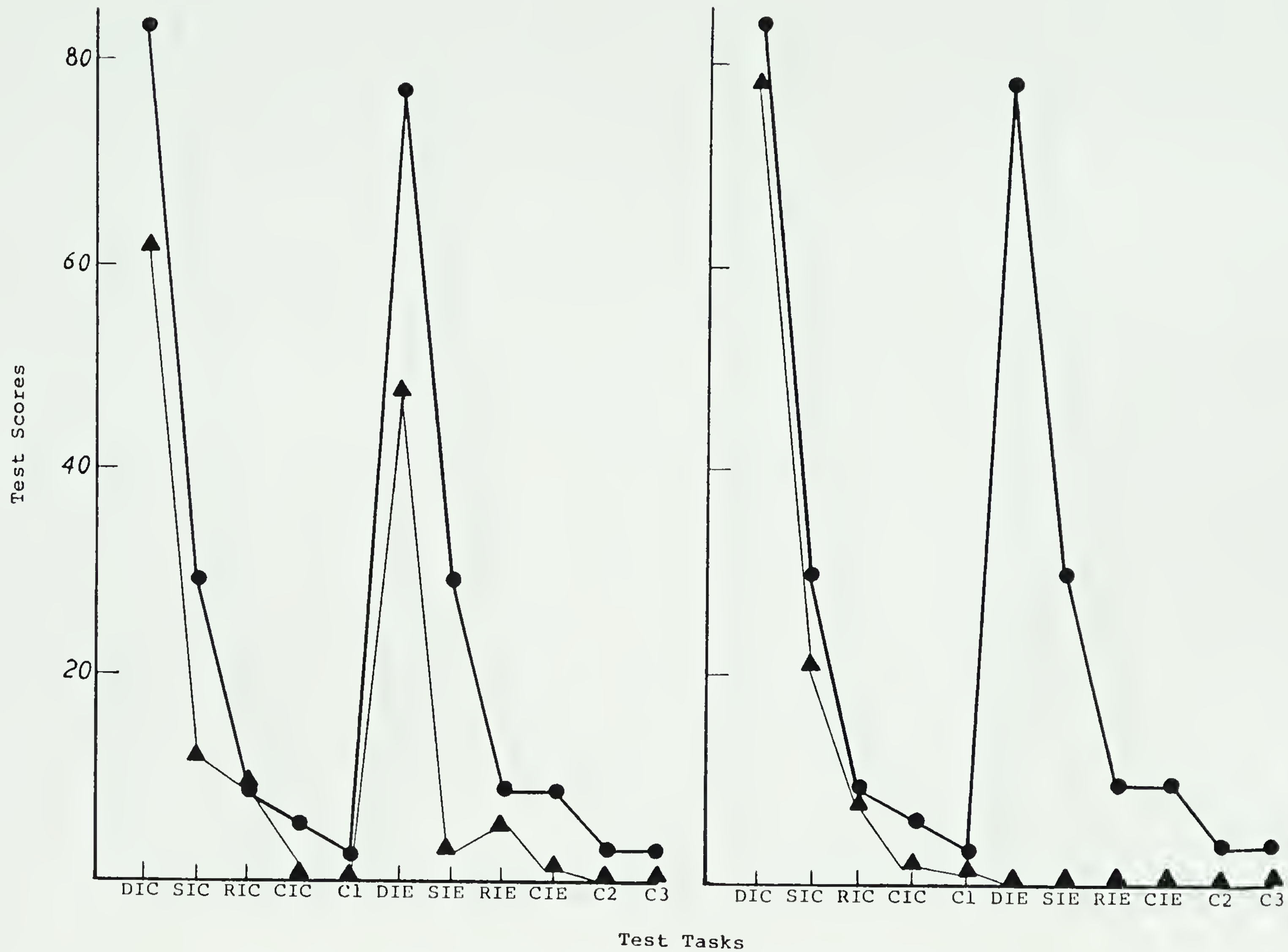


Figure 15. Profiles for Subjects 19 & 20

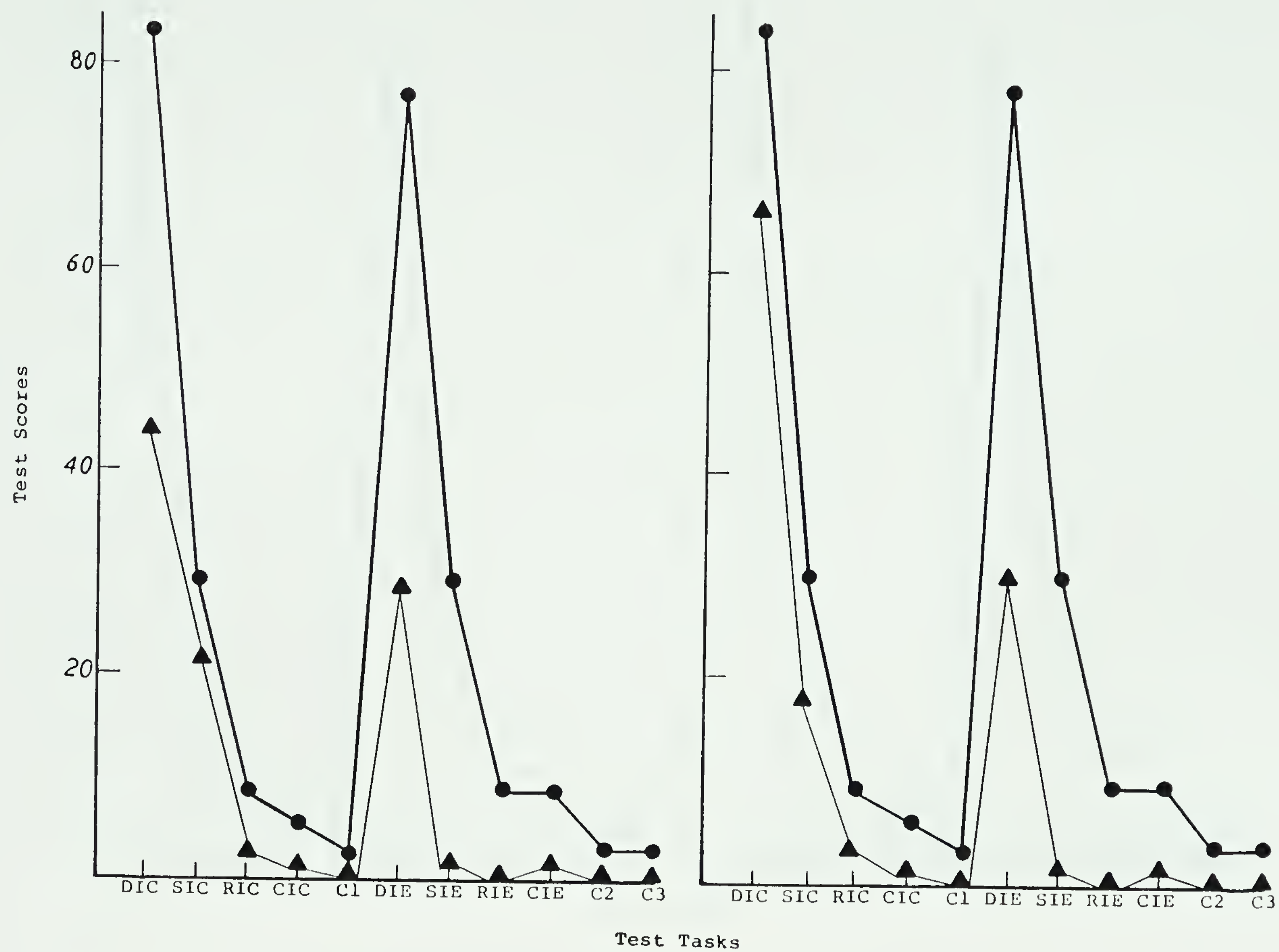


Figure 16. Profiles for Subjects 21 & 22

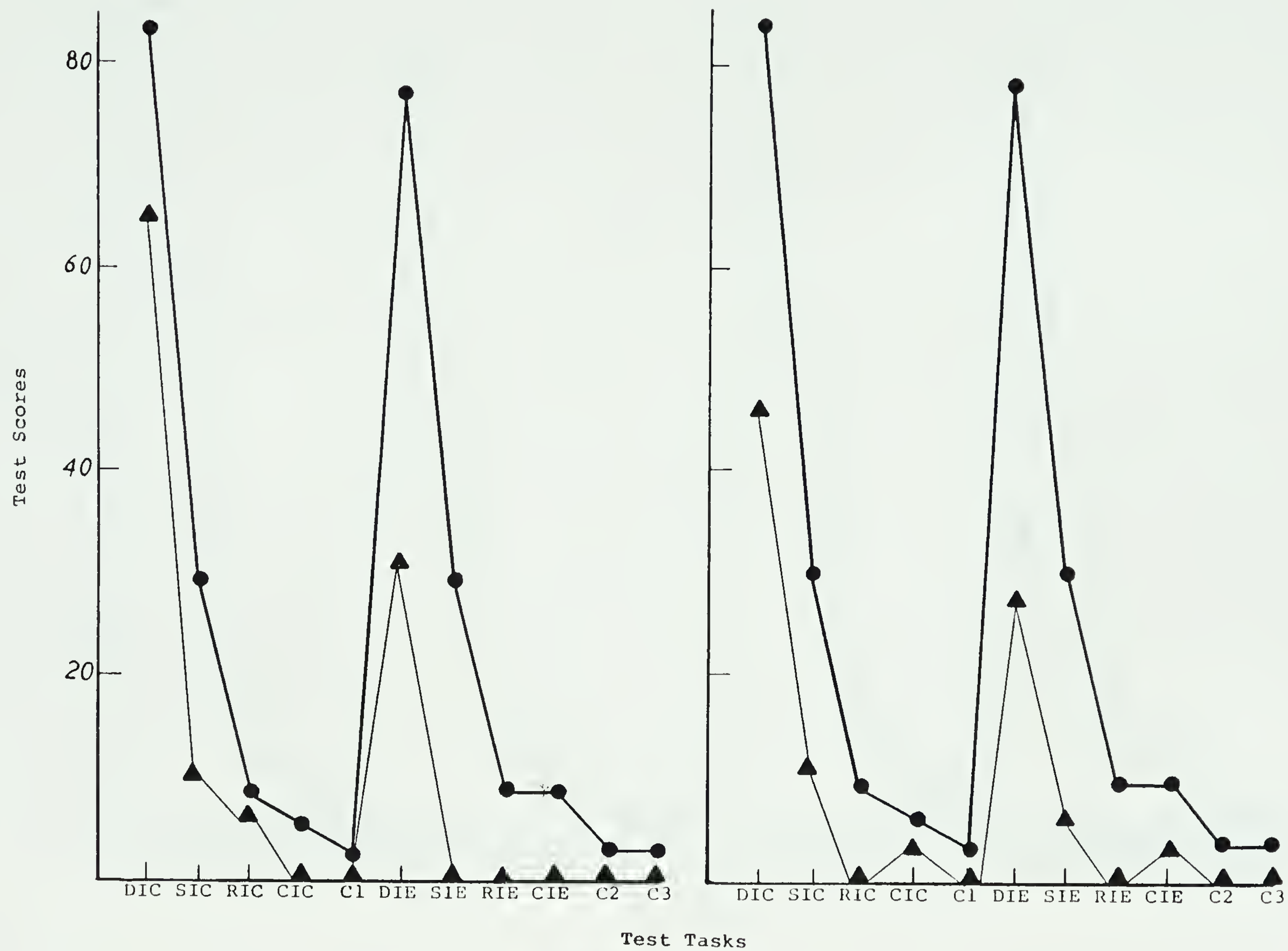


Figure 17. Profiles for Subjects 23 & 24

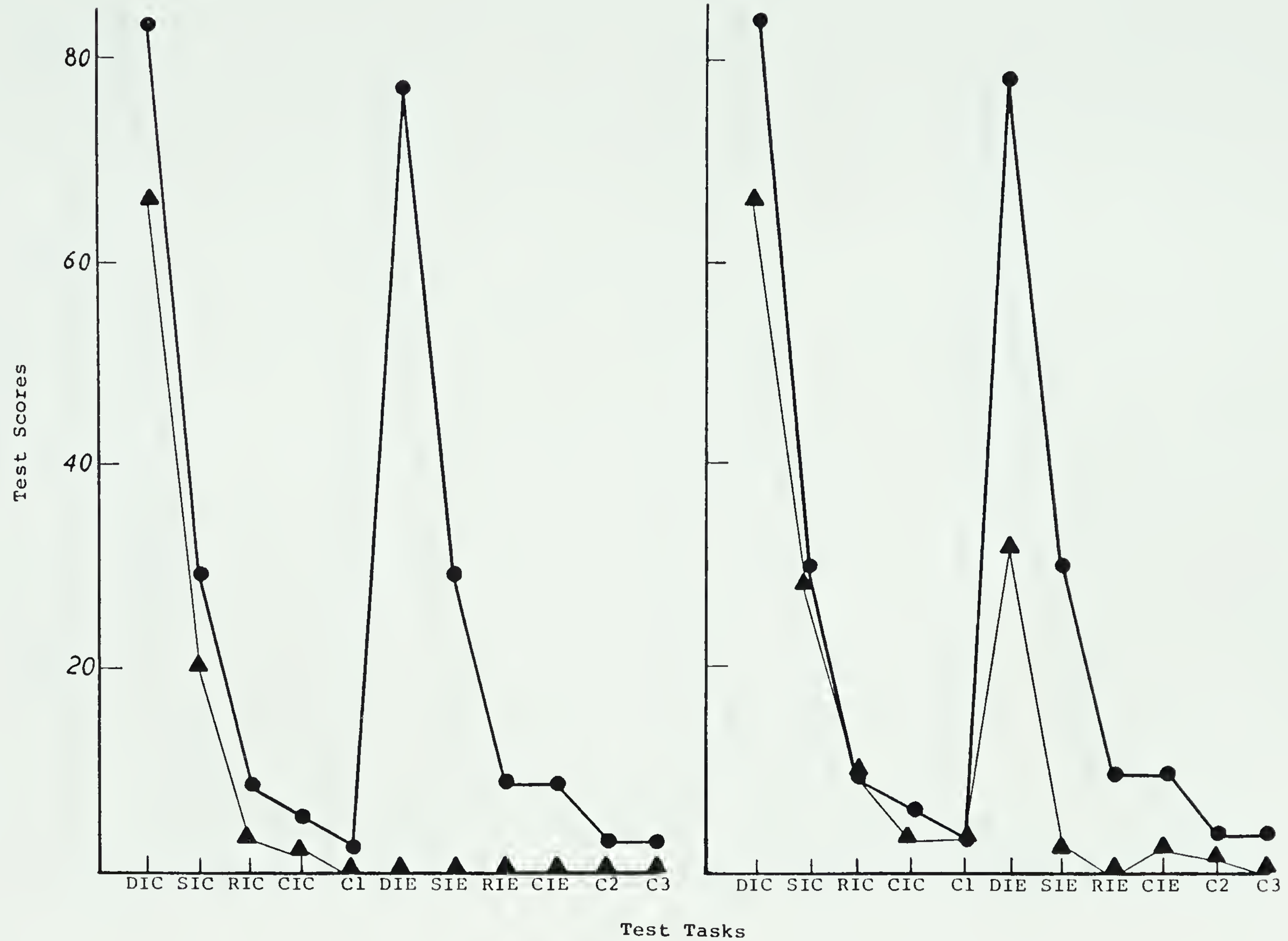


Figure 18. Profiles for Subjects 25 & 26

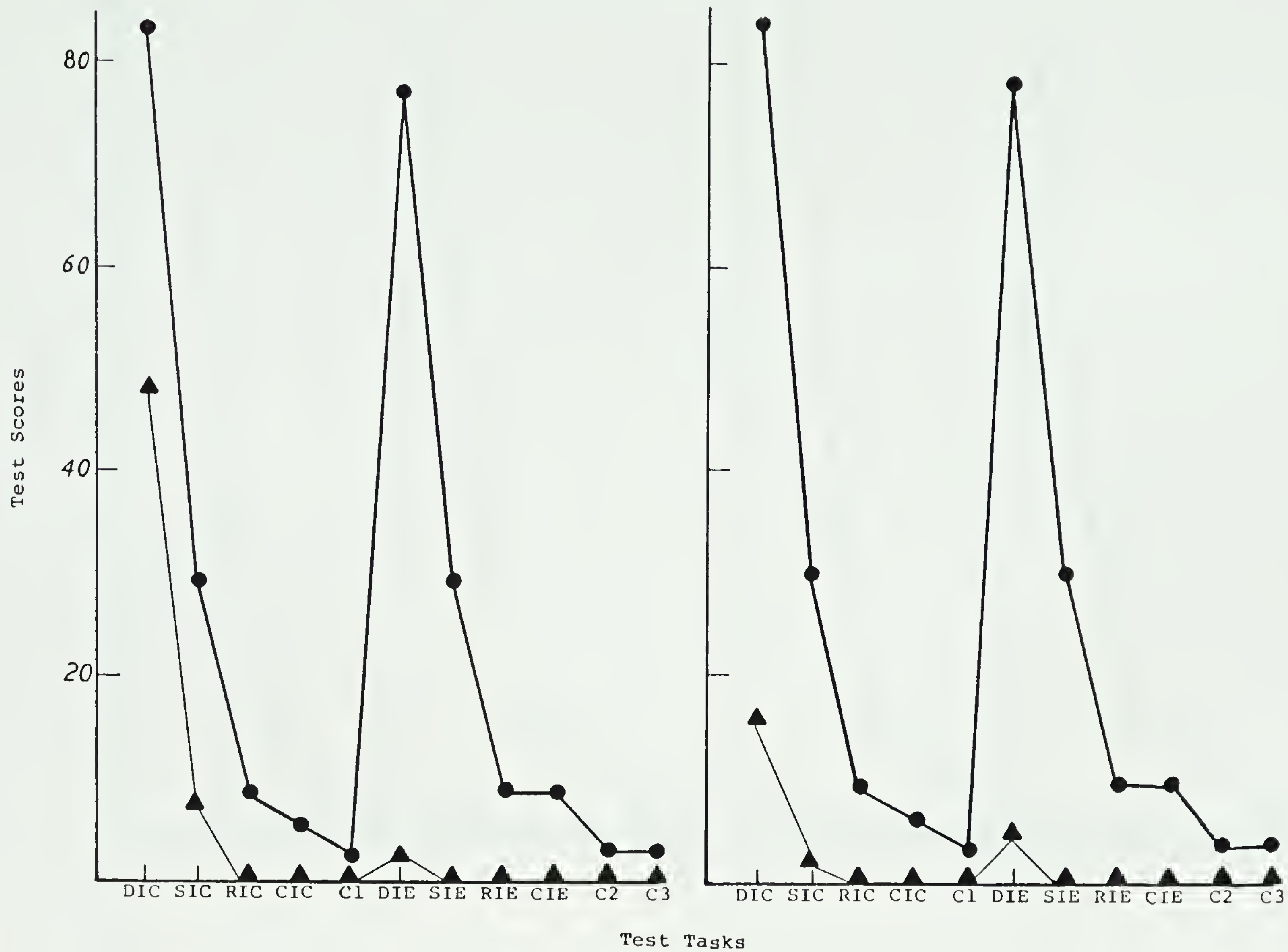


Figure 19. Profiles for Subjects 27 & 28

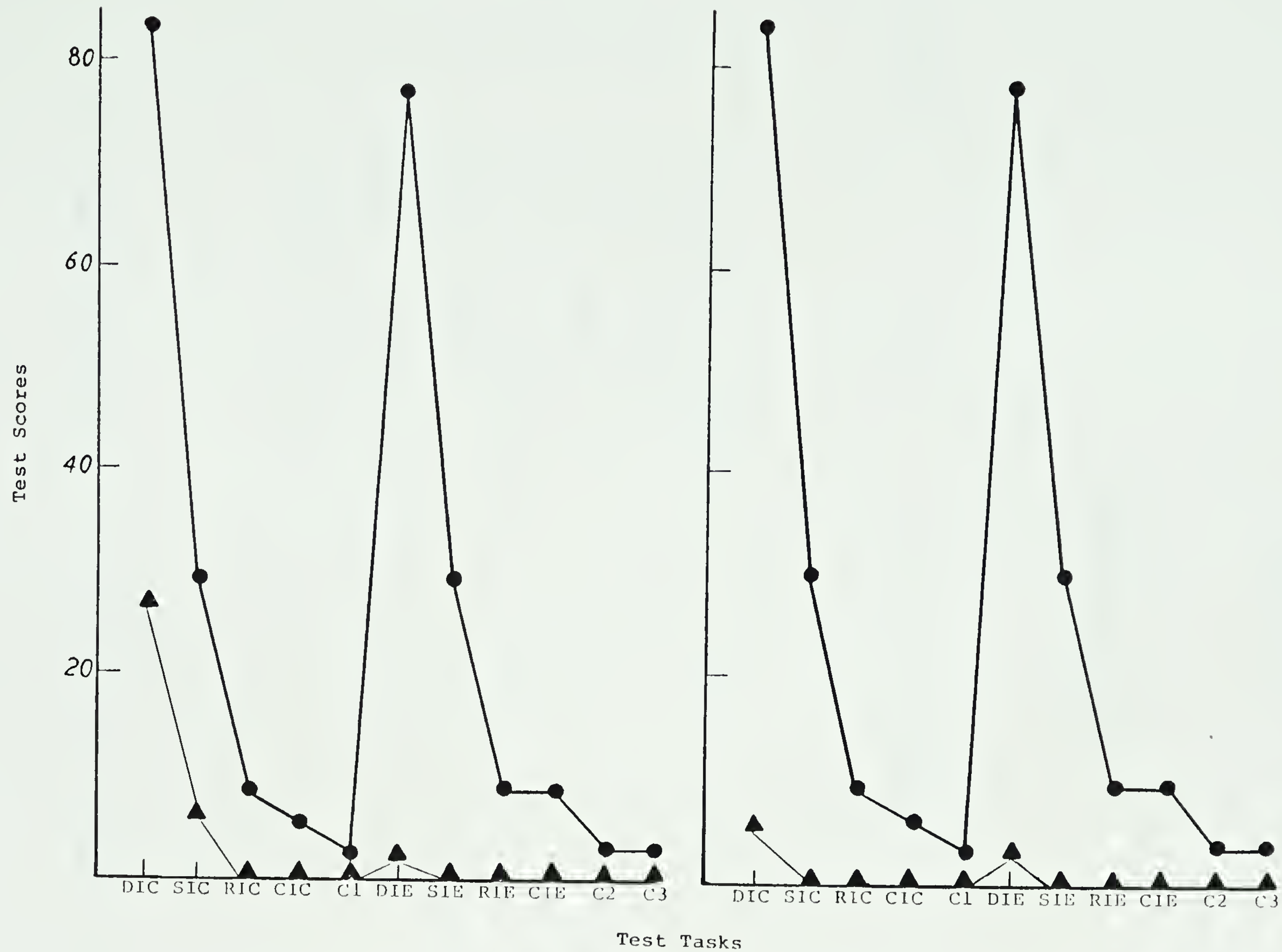


Figure 20. Profiles for Subjects 29 & 30

TABLE 18

Profile Types

Number	Types	No. of Subjects	Profile No.
1	No Loss C Mild E	5	1-5
2	Mild C Mild E	4	6-9
3	Mild C Mod E	6	10-15
4	Mild C Severe E	2	16-17
5	Mod C Mod E	2	18-19
6	Mod C Severe E	7	20-26
7	Severe C Severe E	4	27-30

KEY

C - Comprehension; E - Expression; Mod - Moderate.

TABLE 19

Information Level Means for Different Profile Types

Profile Types*	DIC	Comprehension Means RIC	SIC	CIC	CON1	DIE	RIE	Expression Means SIE	CIE	CON2	CON3
1	83.40	9.00	29.80	6.00	3.00	71.60	9.00	23.40	8.20	2.60	3.00
2	82.75	7.50	29.50	4.50	3.00	72.25	8.25	20.00	7.50	2.75	2.75
3	76.33	7.33	27.50	4.67	2.33	56.33	6.83	12.00	6.83	1.33	1.00
4	76.00	9.00	28.00	6.00	2.00	10.00	0.00	1.00	0.00	0.50	0.00
5	53.50	6.00	15.00	3.00	0.50	45.00	4.00	5.50	1.00	0.00	0.50
6	61.71	4.57	18.57	1.71	0.57	19.14	0.00	1.43	0.86	0.14	0.00
7	24.00	0.00	3.75	0.00	0.00	3.25	0.00	0.00	0.00	0.00	0.00

* Refer to Table 18 for Profile Types

As shown in Table 19, Type 1 subjects (5 in number) mainly have only mild expressive difficulties at Id, Is, and Ic levels. Type 2 subjects (4 in number) have mild comprehension and mild expression problems at Id, Is and Ic levels. Type 3 subjects (6 in number) have mild comprehension difficulties at the denotational, and sentential levels; and moderate difficulties at the denotational, sentential and contextual levels on the expression side. Out of six subjects in this category four were typically anomic (having greater difficulties in expressing nouns, and their numbers, adjectives, and verbs). The other two subjects had main difficulty at the sentential and contextual levels. Type 4 subjects (2 in number) have mild comprehension difficulties at all four levels but severe expressive problems. They had no verbal output but made use of gestures for communication. Type 5 subjects (2 in number) reveal moderate problems at all levels on both expression and comprehension. Type 6 subjects (7 in number) reveal moderate comprehension and severe expression difficulties at all levels. Type 7 subjects (4 in number) reveal severe problems at both expression and comprehension side for all levels.

Profiles also reveal that in general, even the most severe cases retain some comprehension ability at the denotational level, especially for the nouns and body parts; and at the sentential level, especially the understanding of imperatives. This is shown in profile and subject number 27.

Here the profile clearly predicts the performance on comprehension and expression tasks. The profile and subject number 10 indicates a mild problem at relational and contextual levels on the comprehension side but moderate difficulties at all other levels, except the relational level. This profile is an example of an anomic patient who has specific word finding problems that are more obvious at the denotational, sentential and contextual levels. Profile and subject number 22 reveals a rather distinct case. The moderate comprehension problem is seen at all levels, while on the expression side there is very severe loss at all levels, except the denotational level. Profile and subject number 6 indicates mild comprehension and expression problems at contextual and sentential levels.

All the subjects in the seven different categories were examined again in terms of their several independent variables in order to see whether any particular variable had any major role to play in each category. Table 20 summarizes the variable lists for the subjects under each profile type. Under type 1 out of the 5 subjects, 3 are male and two are female; 2 are young, 1 is middle aged, and 2 are old (age basis); and education basis, 1 is elementary, 3 are high school and 1 is university. In types where the No. is too small, e.g., types 4 and 5, a clear cut variable role is indicated but it is not sufficient to draw any conclusions. Table 20 also shows that there are several independent variables interacting with each other and no one variable

TABLE 20

Subject Categories under Different Profile Types

Types	No.	Sex		Age			Education			Language		Etiology			Onset	
	.	M	F	Y	M	O	E	H	U	M	B	MA	CA	OT	C	A
1	5	3	2	2	1	2	1	3	1	2	3	1	3	1	2	3
2	4	2	2	3	1	0	1	1	2	2	2	3	0	1	2	2
3	6	4	2	2	2	2	0	4	2	3	3	0	5	1	3	3
4	2	2	0	0	0	2	1	1	0	2	0	0	2	0	0	2
5	2	1	1	0	0	2	2	0	0	0	2	0	1	1	1	1
6	7	5	2	1	0	6	2	4	1	4	3	0	4	3	4	3
7	4	3	1	1	0	3	4	0	0	3	1	0	3	1	2	2

Key

M-Male	Y-Young	E-Elementary	M-Mono	MV-MVA	C-Chronic
F-Female	M-Middle	H-High School	B-Bi	CV-CVA	A-Acute
	O-Old	U-University		OT-Others	

can be said to have a primary effect on the subject's performance. However, some overall observations emerge from this data which need further investigation. It appears that MVA patients seem to have milder problems (only type 1 and 2) than CVA and 'Others' patients. Subjects with only elementary education seem to exhibit greater difficulties (type 5,6,7) than others with university and high school education. On the basis of age older people seem to exhibit greater difficulties than the younger group. More males seem to have greater difficulties than females in their communicative abilities. Thus profile types and the individual analysis provide a detailed picture of the individual performance at different task levels.

5.5.2 Discriminant Function Analysis

Discriminant Function Analysis (DFA) is a powerful technique for classification. By classification is meant the process of identifying the likely group membership of a case when the only information known is the case's values on the discriminating variables. Here the profile types (Table 18) derived from profile analysis were subjected to DFA in order to validate the data and to predict the diagnostic ability of the test. Thus the DFA was performed on all subjects with their performance scores on all tasks. A direct method was employed for DFA (the direct method assumes that all variables are important in predicting the class membership). Table 21 summarizes the classification results. A 100%

TABLE 21

DFA Classification Results with BDA Subjects

Actual Group	No. of Cases	Predicted Group Membership 1	2	3	4	5	6	7
1 Normal C & Mild E	5	5 100.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%
2 Mild C & Mild E	4	0 0.0%	4 100.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%
3 Mild C & Mod E	6	0 0.0%	0 0.0%	6 100.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%
4 Mild C & Severe E	2	0 0.0%	0 0.0%	0 0.0%	2 100.0%	0 0.0%	0 0.0%	0 0.0%
5 Mod C & Mod E	2	0 0.0%	0 0.0%	0 0.0%	0 0.0%	2 100.0%	0 0.0%	0 0.0%
6 Mod C Severe E	7	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	7 100.0%	0 0.0%
7 Severe C & Severe E	4	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	4 100.0%

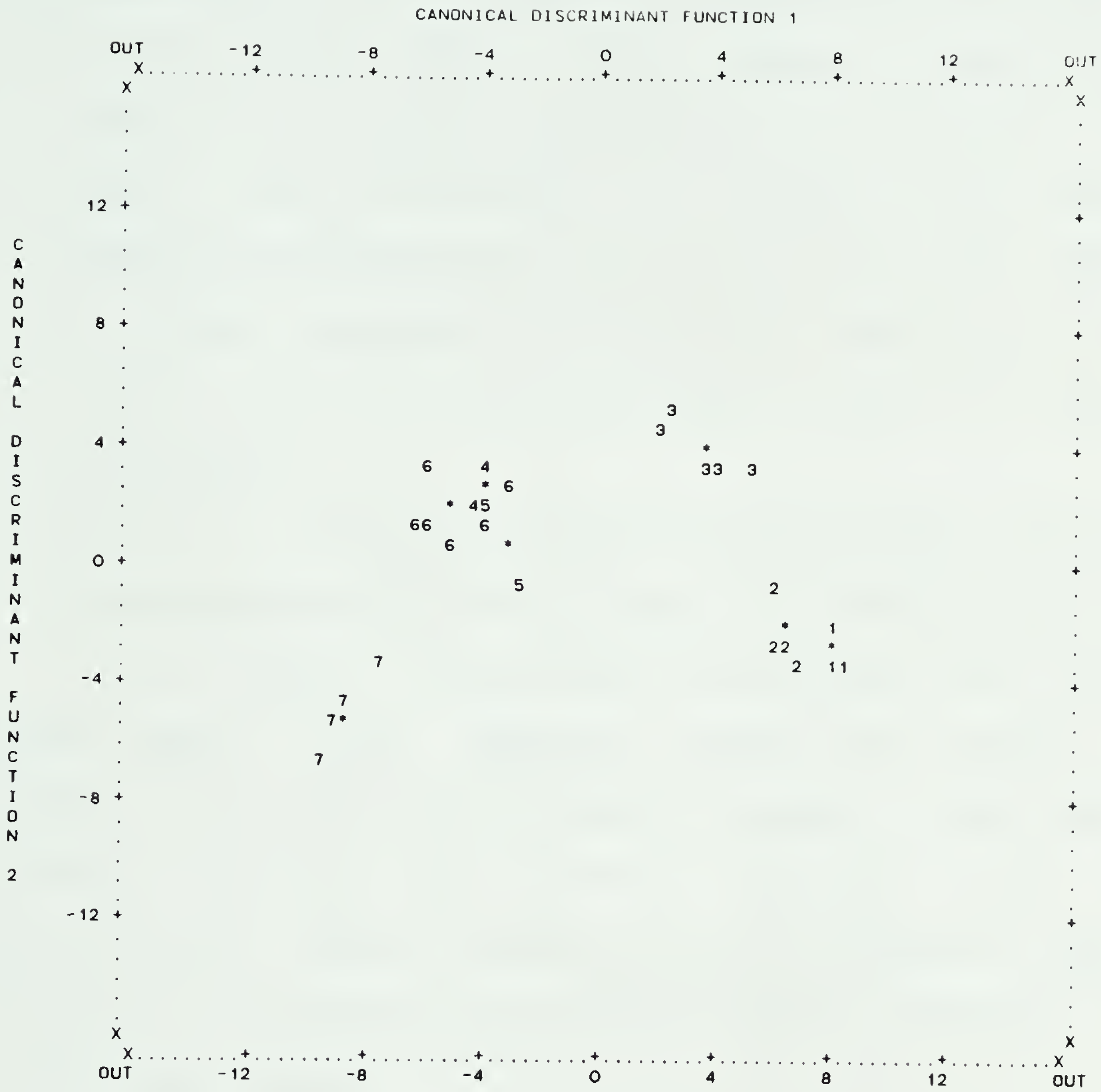
Percent of 'Grouped' Cases Correctly Classified: 100.00%

correct classification is highly significant and this validates the profile analysis data in Table 18. Here in the DFA, six functions are considered to be important for classification purposes.

Function one (which correlates highly with CIC, RIE, SIE and Con3 - mainly expression tasks) distinguishes groups 1,2,3 from 4,5,6,7. Function two (which correlates highly with DIC, RIC, SIC, CIC - all comprehension tasks) distinguishes groups 1,2,7, from 3,4,5,6. Function three (which correlates highly with DIC, RIC) distinguishes groups 1,2,4,5,6 from 3,7. Function four (which correlates highly with CIC) distinguishes groups 2,6 from 1,3,4,5,7. Function five (which correlates with DIE) distinguishes groups 1,5,6 from 2,3,4,7. Function six (which correlates with control tasks 1,2,3) distinguishes groups 1,3,6 from 2,4,5,7. However, functions one and two are considered significantly important for classification purposes.

Figure 21 gives the scatterplot of the canonical discriminant functions. Here * indicates the group centroids i.e., the mean discriminant score for each group on the respective function. Here function one separates groups 1,2,3 from 4,5,6,7. Function two separates groups 1,2,7 from 3,4,5,6, very clearly. Though the seven groups are clearly classified, more convincing evidence for the existence of four clearcut groups is seen. These groups are

1. Group one consisting of subjects with mild comprehension and mild expression difficulties (1,2 in



* Group Centroid

Figure 21. Scatterplot of DFA for BDA Subjects

scatterplot).

2. Group two consisting of subjects with mild comprehension and moderate expression difficulties (3 on the scatter plot). These subjects happen to be anomic, i.e., having word-finding difficulties.
3. Group three consisting of subjects with mild to moderate comprehension difficulties but with moderate to severe expession difficulties seen at all levels viz, DI, RI, SI, CI and Controls (4,5, & 6 on the scatterplot).
4. Group 4 consisting of patients with severe expression and comprehension difficulties (7 on the scatterplot).

It is highly interesting to note that four distinct groups, namely, mild, moderate, severe and anomic, are picked up on this discriminant analysis. This analysis provides validity for profile analysis and 100% classification results account for the diagnostic power of the test in discriminating different aphasic subjects based on their performance on PLTA.

5.5.3 Summary of the results obtained with individual aphasic subjects

The profile analysis done with each subject clearly classifies all the subjects under seven distinct groups. These profile types are further considered valid with DFA results. The scatterplot and a 100% correct classification indicates the predictive validity of the test materials and

the consequent diagnostic power of the test. The DFA results also support the existence of four different groups among aphasic patients, viz., mild, moderate, severe and anomic.

6. DISCUSSION AND CONCLUSIONS

6.1 Discussion

6.1.1 General comments

An attempt at the clinical validation of the Psycholinguistic Test for Aphasia (PLTA) based on the Information Structure model of language has been done. First, several preliminary questions have been answered in order to establish the content validity of the test materials. The performance of normals reveals good range of scores on the test. Systematic differences in the performance of normal subjects with different independent variables viz., age, sex, and educational level was studied. These differences do not seem to be of great importance for the normal group.

The data obtained from normals ranking of the test items for difficulty provide an additional account of the content validity of the test items. The denotational tasks relating to nouns and body parts rank first with tasks increasing in the order of difficulty. A clear-cut one-to-one relationship is not established between different task levels and the information levels as suggested in the

model. From the ranking data obtained from normals, it is clear that tasks belonging to different information levels are mixed in terms of their ranked difficulty. Here, one can visualize the fact that a great number of tasks relating to the denotational level cluster together. The rank order does not follow the hierarchy from denotational to contextual level as suggested in the model. This may be because that the contextual information level, which is the highest in the hierarchy in terms of its function includes denotational, relational and sentential levels. However, the sentential level comprehension tasks, especially the imperatives, seem to be much easier, perhaps because of the presence of a single cue from the intonation contour. Other tasks eliciting sentential information on the expression side seem to rank high. Here the tasks were artificial in the sense that hand puppets were used to elicit interrogatives and imperative sentence types. Similarly the expression of adverbs (where the possibility of correct responses was more than one for a single stimulus situation) was ranked high in difficulty. The task on the expression of focus that involved spontaneous speech was also considered difficult by normals.

Thus the ranking data supplied by normals seem to divide the test tasks into two main categories. viz., simple constituent or intonation cue *versus* complex constituent. Here, the simple constituent is more attributable to the denotational elements and the complex or the multiple

constituents are more related to the relational, sentential and contextual levels. Note that the contextual level makes use of all the other level elements. For example, the tasks for denotational informational level, i.e., the expression of nouns, body parts are first in the order, while at the end of the scale are tasks relating to contextual level (focus) and sentential levels (these tasks make use of multiple constituents). This type of ranking data does provide evidence of a hierachy in terms of function as suggested by the Information Structure model (Prideaux, 1979). This is further supported by the fact that all the ranks of difficulty obtained differed significantly from one another. The ranking hierarchy establishes the fact that 'test tasks vary in terms of difficulty', which is an important aspect of test construction (Benton, 1967).

The control group consisting of BDNA subjects performed like normals and greater variations in PLTA scores due to educational factors or any other independent variables were not seen in this group either. The outliers in this group were those scores given by institutionalized patients. Though a one-to-one relationship could not be established between institutionalization and PLTA scores, a suggestion is made regarding this factor. It would be ideal to look for such factors in testing the clinical population, whether in the control group or the experimental group. Thus the performance of BDNA subjects in obtaining good scores accounts for the content validity of the test materials. The

deviant scores obtained by the BDNA subjects again related to sentential information tasks (imperatives and interrogatives) on the expression side. It is possible that right hemispheric damage in these patients could account for such scores, but localization data were not available on these patients obviating any attempt at investigating this possibility. Some senior citizens in the normal group also obtained lower scores on these tasks. This correlates with the data obtained on the difficulty ranks given by normals. The sentential information level tasks were ranked high, indicating greater difficulty. Here the artificiality of the test task with the puppets might have led to lower scores and this factor may need further investigation.

The investigation of the discriminant power of the PLTA has led to several interesting observations. The DFA results indicate 92.92% on the overall correct classification with BDA and normal controls. This result appears to favour the predictive validity of the test. The results do suggest a high degree of effectiveness of the PLTA. The BDA group responses were strikingly different from normal and BDNA group thus supporting the main hypothesis as stated in Chapter One. The performance of thirty subjects in the BDA group at different information levels offers further support to the predictive validity. In general, the comprehension abilities at all levels seem to be much better than the expression abilities (Tukey test results supports this data). Even the severe patients retain some denotational

information (especially for nouns and body parts) on the comprehension side. This is further consistent with the ranking data obtained from normals. The denotational expression and comprehension tasks (mainly the nouns and body parts) were considered easiest by normals. Subjects with milder difficulties perform well at the denotational and relational levels as compared with other levels. However, subjects with moderate to severe loss have difficulties at all levels. In this group, the anomic subjects were classified separately (the DFA scatterplot, Figure 22, illustrates this) and these subjects especially had problems at the denotational level for nouns, adjectives, verbs and number on the expressive side. The anomics seem to perform differently from other groups at all levels. Their word-finding difficulties are further confirmed on tasks relating to the expression of relational information, where the lexical elements are provided to the subject and he has to describe the relationship among these elements by looking at the picture.

The aphasic data reveal the varied performance of aphasics at different information levels. For example, the milder subjects perform well at the denotational and relational levels on the expression side because the former involves the single word utterances and the latter the relationship among these different denotational elements. The performance offers support to the distinction between denotational, i.e., single element versus contextual i.e.,

syntactically complex elements. In the order of hierarchy, the sentential comprehension, i.e., imperatives, seemed to be better retained by aphasics. This corresponds further with the normal ranking data, as normals ranked these tasks at the lower end of a scale.

The inclusion of control tasks consisting of narration, comprehension and expression of logical sequences seems justified. They form part and parcel of the contextual information, since they make use of complex constituents, one's knowledge of the world, sequence of elements and their occurrence, etc. Aphasics with mild difficulties do well on these tasks and aphasics with moderate to severe difficulties exhibit poorer performance on these tasks. Logical sequencing is a crucial factor in communication and these tasks indicate its importance as a part of the testing system.

The systematic relation between the degree of aphasic disorders and the PLTA scores was established through profile analysis and DFA. These results parallel the aphasic categories obtained by Powell, Clark and Bailey (1979) who submitted Schuell test scores obtained from 86 aphasic cases to cluster analysis, and obtained four groups, aligned along a dimension of severity. However, the severe, high-moderate, low-moderate and mild types do not separate out on the processes of comprehension and expression. The profile types highly correlated with the test scores, here the unique feature being the distinction drawn between comprehension

and expression tasks. The PLTA scores seem to be a valid measure of the degree of aphasic disorders. The tasks that were ranked high by normals, viz., the expression of adverbs, imperatives, interrogatives and focus also seem to be difficult for aphasics with moderate to severe problems. Aphasics with milder problems seem to do well on these tasks. The test's sensitivity could be improved by changing certain tasks that were ranked extremely high by normals.

It appears from certain of the test results that further work needs to be done along the following lines to refine the instrument. For example, the denotational, sentential and relational levels of language really may be considered in some senses independent, but that the contextual level is dependent on all other information levels. With relational tasks, given the denotational elements, only the relationships have to be identified or expressed. The sentential information tasks are aided by the primary cue of intonation contour and also by word order etc. But the contextual level seems to be dependent on all other information levels. For example, the failure on given-new tasks may be relational in nature. This is further suggested by the study that some patients with difficulty at the relational information level also have difficulty at the contextual information level.

At the contextual level, the development of given-new tasks could be confounded. Here, these tasks may have to be described in detail to more than phrase-structure

constituents. Even the topic tasks are not based on pragmatic grounds. Many of the tasks, which were theoretically designed, could not be applied practically, as they were not able to be depicted through pictures. Hence the development of contextual tasks in greater specificity was not possible.

Even in the Information Structure model, the contextual information level is perhaps not completely defined. It is a possibility that other contextually-determined syntactic structures, may be defined, and in addition the model does not account for the imporatant role of non-verbal context. From the results on the test tasks, it appears that the contextual level is the least clearly specified and investigated level both in the model and in the test, and it needs extensive theoretical and practical work before it can be included in any standardized test. In addition, the contextual level is considered to be difficult because of its functional complexity and it may be tested through extra experimental manipulation of the test tasks. This aspect of testing needs further investigation.

With regard to the sentential information level, the main information involved is that of the speech acts, where major cues can be got from the sentential intonation patterns and content words. The sentential level, at least in non-complicated utterances, does not need much access to relational information. It can be considered as an independent level since the word order can also account for

the comprehension and expression of sentential tasks. This is evident from the results obtained on sentential expression tasks; even given the intonation cues, aphasics have difficulty in expressing the interrogatives and the imperatives.

The tasks for relational level do not distinguish between syntactic, or grammatical, relationships such as subject or object and semantic, or case, relationships, such as agent or patient. It is very difficult to achieve this distinction in a testing situation, since factors like plausibility and semantic constraints confound attempts to get at these complex strategies. This is a topic for further research.

6.1.2 Psycholinguistic view points

From a psycholinguistic point of view, the aphasic data obtained in this study provide an immense amount of information. The denotational information level as defined in the Information Structure model (Prideaux, 1979) seems to be the basic level among the information types, and an organic breakdown still results in the preservation of some denotational elements, especially the nouns. These retained forms parallel the early learned child language forms. For example, children seem to acquire the nouns (or the denotational elements) much earlier than other complex

constituent elements.[26] These nouns are high content items, and a relationship between them may often be inferred without need for other linguistic material, thus implying high communicative value.

As the PLTA results indicate, the sentential information level, especially the comprehension of imperatives (following the commands), is retained by aphasics (even the severe cases) to a great extent. This also parallels the acquisition data. Children seem to obey commands or respond to the imperative form of sentences at an early age. The preservation of these two information levels even among the severe aphasic types suggest that denotational and sentential forms are basic and critical communicative devices. In terms of language use, the denotational forms have a more basic function. This view point strongly supports the Information Structure model's claim that denotational level forms the basic level of Information Structure and its function is very critical in the use of language for communication.

The contextual and relational data are only relatively preserved, depending on the severity of aphasia, although the caveats expressed above about the contextual level of the test must be observed here. Aphasic patients with difficulty at the relational level do have problems at the

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[26]Here no analogy is made to the Jackobson's hypothesis. This is an observation based on PLTA test results and a large data base has to be accumulated to formulate any kind of hypothesis.

contextual level.

The results of aphasic data reveal some parameters of the model that need to be clarified. For example, it is made evident that the difficulty of information is a different matter from the difficulty of structure. The sentential information level (assumed to be difficult in structure) is better preserved than the structurally simpler relational information level as it distinguishes among informationally simple speech acts, distinguishing commands from questions from statements. Hence, the model does not adequately predict the levels of difficulty because the notion of difficulty needs to be broken into (1) difficulty of information based on semantic constraints and (2) difficulty of structure based on complexity. However, since the theory does make claims about the hierarchy of forms based on the levels of information and the functions relating to those forms, such claims allow one to investigate the difficulty of information and the difficulty of structures differentially. As noted above, the sentential information level is coded by fairly complex structures, namely, whole sentences, word order and intonation cues. But the sentential level conveys simple information in the form of speech acts. Thus it is possible that a level making use of complex structures may convey simple information and a level making use of simple structures, for example, relational information, may convey difficult information. The denotational level is very straightforward and simple.

The results of the test, which, it should be remembered, deals primarily with concrete, frequently-occuring referents, are compatible with the model's assumptions that the denotational level is the simplest and most basic sort of information. The results show that aphasics, depending on the severity of their impairment may have problems with relational, sentential and contextual information levels but perform well at denotational levels.

Here the structures preserved among aphasics do not support the hierarchy of forms based on difficulty[27]. Instead, these preserved sentential forms in comprehension support the view, that information levels form an hierarchy in terms of their communicative importance, i.e., in terms of the 'function' they serve. Here, the sentential information level makes use of complex constituent elements but their function appears to be quite simple.

The aphasic data account for the construct validity of the test. Here, the construct refers to language and the consequent Information Structure model on which the language test is based. The model's validity is further ascertained by the fact that aphasic data support the important propositions given by the model: One is that language is meant to convey information and there are types of information levels which form an hierarchy depending upon

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[27] This is the general notion understood by linguists who presume that the hierarchy of forms in a language is based on some notions of syntactic complexity and size of constituents involved.

their function. Two is that linguistic devices used to form these information levels can be relatively preserved depending on the extent of brain-damage. The test results provide a taxonomic system for an inventory of aphasic behavior, and the test provides multiple measures of a patient on different information levels of the Information Structure model.

The test demarcation based on comprehension tasks and expression tasks does provide some valuable information on the psychological processes involved with language act. The aphasic data suggest that comprehension is a prerequisite to expression and that in a organic breakdown, comprehension is relatively better preserved than expression. In fact, comprehension is always better, in this subject pool, than expression. And at times, comprehension is equal to expression. The comprehension of denotational and sentential forms is relatively better preserved than their expression counterparts. Even some of the severe patients retain good comprehension of denotational level (nouns and body parts) and sentential level (imperatives) forms. The test results did not indicate any patient with total comprehension loss but good expression. All patients had relative degrees of comprehension and expression difficulties. On the other hand, test results have shown that patients with good comprehension can have some expression difficulties.

These results suggest psycholinguistic implications for a process theory. Here the product, i.e., the language forms

(information type devices) are communicated through two processes, viz., comprehension and expression, and to a great extent expression depends upon comprehension. The results suggest that from a psycholinguistic point of view, a true case of aphasia with good expression despite total comprehension loss would be imposssible to find. With future research, the aphasic data on comprehension and expression tasks may provide more complete hypotheses in regard to the process model of language use.

Thus the results of these data are of use to psycholingiusts because of the feedback it gives them about the Information Structure model and also about other psycholinguistic assumptions that might be drawn from it. The results also suggest that the model should be expanded to make differential claims in terms of the hierarchy of structures or function. Here the assumptions refer to the processes of comprehension and expression and parallels seen with aphasic data and children's acquisition data.

6.1.3 Clinical view points

The PLTA test results seem to be of help to the clinician from two points of view: (1) what it tells the clinician about the aphasic deficits and (2) what it suggests for therapy. To the clinician who is interested in understanding aphasic language deficits from a psycholinguistic perspective, the results suggest the following.

An organic breakdown can result in language loss which is manifested differently with different individuals. The language loss is seen to be of different degrees on the comprehension and expression side. The language retained by aphasics can be described in terms of the information level types as suggested by the Information Structure model and as described in the test. The best retained forms are of the denotational type and the relatively preserved forms belong to sentential and contextual levels as these types clearly separate out in terms of the importance of function they serve in communication. The anomic cases with word finding problems exhibit difficulties with nouns and verbs at the denotational and sentential levels. And they perform well at the relational level which involves relationships among the denotational elements. Thus the PLTA test results reveal a systematic defect of language among aphasic patients. The test results provide a functional decomposition of the knowledge of the language along the lines described in the Information Structure model. The test results provide a taxonomic system for an inventory of aphasic behavior by describing the aphasic patient's performance on many discrete functions.

Therapeutically, the test results offer the clinican very salient guidelines. Language therapy starting from the level at which information is best preserved seems to be the ideal step that emerges from this test data. Remediation of the comprehension aspect of language separately from its

expression counterpart is also indicated. The gestural responses accepted in the test emphasize the importance of gestures in therapy. Firstly, gestures do convey the aphasic subject's comprehension and expression abilities. Here the aphasics retain the ideas to be communicated in their cognitive component but have lost the verbal tools to express them. Secondly, such gestures could be used in conjunction with verbal tools in language therapy. Gestures seem to allow an important mode of communication for patients with good comprehension but severe expressive difficulties. For example, on naming tasks, failure to name means that the subject do not get the correct score. If the subject responds to such tasks by gestures, that is, by pointing to the function denoted by the object, then it means that the subject recognizes the object and this can be considered to be a partial response. This further supports the validity of the Information Structure model. As language therapy involves the use of verbal tools, this test based on linguistic description of the language use will permit one to determine the severity of aphasic disturbances in a precise way.

Thus the results on this psycholinguistic test clearly show defective language on all information levels systematically, and the findings of such an analysis provide the basis for rehabilitation therapy. The test results have shown the possible interaction of several variables viz., sex (female); education (university education); age (younger

age group); etiology (MVA) and onset (acute) along with speech and language therapy in the spontaneous recovery of the patients. Thus the test results discussed above suggest the 'clinical validity' of the Psycholinguistic Test for Aphasia.

6.2 Summary

The main objective of the present study as given in Chapter One relates to the development of a test for aphasia based on the psycholinguistic model of language proposed by Baker (1976) and Prideaux (1979) and its consequent clinical validation. This Information Structure model accounts for the description of linguistic forms at the surface level along with the functions these forms signal. Hence the model suggests that there are four levels of information that are encoded in every sentence. These levels range from simple denotation (nouns, verbs, adjectives, prepositions, negation etc.) through relational information (modification, grammatical roles) and sentential information (questions, statements) to subtle discourse-structuring contextual notions which may direct the choice of alternative syntactic forms (active vs. passive sentences). The model claims that it is the choice of information from each of these levels which directs the form (structure) of the sentence.

The aphasia test described in this thesis and based on this model investigates whether the various categories of

information together with their syntactic encoding are retained or lost in aphasias. As such, the test consists of tasks eliciting performance on the expression and comprehension of language forms associated with the information levels. The experimental component deals with the clinical validation of the psycholinguistic test and the consequent analysis of aphasic responses.

To summarize, the results of the experiments on PLTA conducted with normals, BDNA and BDA subjects have led to some answers to the list of explicit questions mentioned in Chapter One. These questions are repeated here, along with their answers.

1. What is the behavioral nature of language impairment and the levels at which the impairment occur in aphasia?

   Aphasic subjects' behavioral nature of language impairment is varied and relates to comprehension and expression at denotational, relational, sentential and contextual levels. Even the most severe patient seems to retain some denotational information as it forms the basic level.

2. What is the performance of normals and controls (BDNA) on the proposed test?

   Normals and BDNA subjects seem to perform in the same way with no significant difference at different information levels. As a group their responses range form 90-100% on both comprehension

and expression tasks.

3. What is the validity of Information Structure model (Prideaux, 1979) as a description of language behavior in explaining aphasic performance?

   The results with aphasic data reveal a systematic defect in language at all levels. Aphasics' ability to perform better on comprehension tasks (especially on denotational types and sentential imperatives) suggests a trend towards hierarchy of the informational levels. The control tasks (involving logical sequence) seem to be the hardest in terms of hierarchy and that should be a part of the contextual information in the model described. Aphasic data does support the theoretical assumptions mentioned in the model.

4. What assumptions can be drawn from the test results about the nature of language impairment among aphasic patients?

   The gestural responses given by the aphasic subjects do suggest that some of the aphasics who retain the cognitive component but lack the verbal tools, substitute gestures to convey the ideas. Gestures here seem to be an important aspect of communication. This ability of aphasic patients to use gestures is more seen among subjects with good comprehension and poor expression. The test results support the hypothesis that 'expressive

aphasics with good comprehension might have lost only the verbal devices to convey the ideas.'

5. How can the test results be incorporated in rehabilitating aphasic patients?

The results of aphasic subjects on this test clearly show defective language on all information levels systematically and the findings of such an analysis provide the basis for rehabilitation therapy. An example of such an approach would be to begin the patient's retraining with material from the information category best retained. If the aphasic subject has better comprehension than expression at all levels then therapy to stimulate expression at levels starting from the denotational level would be an ideal step.

6.3 Conclusions

This study relating to the 'development and clinical validation of a psycholinguistic test for aphasia' bridges the gap between the two fields namely, linguistics and aphasiology; and it is a trend towards intersection between the two fields. It has offered immense data to the psycholinguist who is interested in investigating the language behavior of adults with an organic breakdown. To the speech pathologist, this PLTA is an additional tool in clinical aphasiology as testing the aphasic patient aids in

rehabilitation and prognosis. The test clearly predicts the psycholinguistic abilities of aphasic patients and can provide a baseline for language therapy.

As mentioned in Chapter Five, some factors seem to require further investigation. The use of hand puppets in tasks eliciting sentential imperatives and interrogatives can be substituted for by pictures. Similarly pictures relating to the comprehension tasks of relational information can be changed, too. The tasks eliciting spontaneous speech can be changed to tasks eliciting information on a specific topic.

With regard to the tasks designed for the expression of verbs, a word 'drinking' is used. In this form the stem of the verb 'drink' is a noun form, and it is possible that some patients may understand the noun form and respond to the task. In future, it is advisable to add verbs without clear noun correlates so that the verb form alone can be tested. The problems mentioned with regard to the test tasks need to be worked upon.

The results of the study suggest that the tasks incorporated in the contextual level can be changed suitably. The given-new tasks can be related to more than phrase-structure components. The given-new tasks and the topic tasks can be even context related. A specific elicitation of responses at the contextual level is possible only through a good deal of research work and this is suggested for future work. With regard to the contextual

level of information, even the model needs to be worked upon. The model may have to consider the non-verbal responses to fully specify the contextual level of information.

In this study the interaction of several independent variables (sex, age, education, languages known, etiology, and onset) could not be studied statistically as the number of subjects under each condition was too small. Thus, further research to explore the interaction factor involving a greater number of subjects needs to be done. Further research involving a greater number of aphasic subjects is also suggested for standardizing the test on a larger population. A greater number of institutionalized patients (BDNA) should be studied to see how they perform on the test despite having no clinically identified specific language problems. This study has provided a research tool that needs to be finely tuned before it can be used as a routine test.

Cross-cultural studies, i.e., studies involving aphasic patients speaking different languages, can be attempted by translating the PLTA materials into other languages. Further validation of the test involving a different aphasic population is also suggested as a part of cross-cultural validation.

In the present study, the experimenter, who developed the test, had learnt English as a second language and no external check to control for 'accent' as a variable was undertaken. On a subjective basis other clinicians felt that

accent probably would not have made any difference in the test results. However, further establishment of the concurrent validity between experimenters is suggested as a research study. In this study, the other aspects of aphasics' responses viz., time taken, speed, repetitions and hesitations were not studied, as the experimenter felt that they did not convey a great deal of information on the subjects's psycholinguistic abilities.

Despite some of the limitations listed above, this study has answered the questions of content validity and predictive validity of PLTA. The results of the testing have made useful contributions to the psycholinguistic theory. The Information Structure model seems to be a useful description of 'language' in terms of its function and this is further supported by the aphasic data. The hierarchical information levels mentioned in the model draw special mention in the sense an organic breakdown results in language loss to retain certain functional forms of the language better than other functional forms. And these functional forms represented through different information levels parallel the hierarchy described in the model. Further modifications of the test as suggested can be undertaken as a part of standardization and after these modifications 'PLTA' can be used as a routine test in diagnosing the aphasic population in specific and the brain-damaged population in general.

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APPENDIX A: Test Protocol

Note: With aphasic patients cues are given in the form of gestures whenever the patient fails to understand the verbal instructions. For each task the instructions are repeated twice. The test is stopped if the subject fails on three consecutive tasks. The sentence cards are shown to the subjects whenever they are involved in the instructions. For subjects with motor problems, help is given during the sorting tasks (involving categories and logical sequences).

I. Tests for denotational information.

A. Tests for comprehension.

Sub tests:

1. Identification of nouns
   Here are some objects and you point to the objects named by me:
   Show me the pen.
   Show me the pen.
   Show me the spoon. (or any three objects out of the six objects used, viz., pen, pencil, spoon, fork, matches and coin.)

2. Identification of body parts.
   You point to the body parts named by me.
   Show me your hand.
   Show me your mouth.
   Show me your ear. (or any three body parts)

3. Identification of verbs.
   Here are some pictures (no. 1) and show me:
   Which picture describes someone drinking?
   Which picture describes someone jumping?
   Which picture describes someone playing?

4. Identification of time.
   Here are two pictures (no. 2) and there are two sentences that describe them.
   Show me which picture describes this:
   He is breaking the dish.
   He has broken the dish.

5. Identification of adjectives.
   Here are some pictures (no. 3) and point to the following:
   Picture of a tall woman.
   Picture of a big house.
   Picture of a small ball.

6. Identification of adj+N.
   Here is a picture (no. 4) and point to the picture of a black cat.

7. Identification of N+Rel clause.
   Here are three pictures (no. 5) and point to the picture of a dog that is barking.

8. Identification of prepositions.
   Here are some pictures (no. 6) and there are three sentences that describe them.
   Show me which picture describes this sentence:
   The apple is on the box.
   The apple is in the box.
   The apple is under the box.

9. Identification of adverbs.
   Here are some pictures (no. 7) and there are three sentences that describe them.
   Show me which picture describes this:
   The girl walks slowly.
   The boy is here.
   The is boy is there.

10. Identification of noun number.
    Here are some pictures (no. 8) and point to the following:
    Picture of balls.
    Picture of a watch.
    Picture of gloves.

11. Identification of categories.
    Here are some pictures (no. 9) and they belong to two differnt groups. Can you sort them into two groups depending on the things that are alike.

12. Identification of negation.
    Here is a picture (no. 10) and there are two sentences.
    Show me which sentence describes the picture:
    He is drinking water or he is not drinking water.

B. Tests for expression.

1. Expression of nouns.
   Here are some objects and name any three of them. (The objects are: pen, pencil, spoon, coin, matches & fork)

2. Expression of noun number.
   Here is the picture (no. 11) of a fan (or box). Now, here is an other picture and ther are two... (fans or three boxes).

3. Expression of body parts.
   Name any three of your body parts.

4. Expression of verbs.
   Here are some objects (objects used for eliciting nouns) and can you tell me for what they are used for?

Key, pencil, spoon. (Here the subject can chose to describe the use of any object.)

5. Expression of time.
Here are two pictures (no. 12) and tell me
What the boy is doing here?
What has he done there?

6. Expression of adjectives.
Here are some pictures (no. 13) and this is the sentence frame (the sentence card is shown here). Fill in the appropriate word in this sentence.
This is a ..... spoon.
An elephant is a .... animal.
He is a .... man.

7. Expression of categories.
Can you name any five colours?
Can you name any five animals?

8. Expression of adverbs.
Here are some pictures (no. 14) and you answer to the following:
How does this train move?
Where is the picture of a horse?
How does the girl pull the rope?

9. Expression of negations.
Here is a picture (no. 15) and I ask the question 'is the girl reading'?

10. Expression of prepositions.
Here are three pictures (no. 16) and this is the sentence frame. You fill in the appropriate word here.
The cat is .... chair.
The cat is .... chair.
The cat is .... chair.

II. Tests for relational information.
A. Tests for comprehension.
Subtests:
1. Identification of subject.
Here are two pictures (no. 17) and there are two sentences. Show me which picture describes this sentence:
The cat is chasing a dog.
A dog is chasing a cat.

2. Identification of DO/IO.
Here are two pictures (no. 18) and there are two sentences that describe them. Show me which picture describes this:
John is giving flowers to Mary.

Mary is being given flowers by John.

B. Tests for expression.

1. Expression of S/DO/IO.
Here is a picture (no. 19) and this is John, this is Mary and this is a book. Can you tell me what is happening in the picture?

III. Tests for sentential information:

A. Tests for comprehension.

1. Identification of imperatives.
I ask you to follow these commands:
Stand up.
Point to the ceiling.
Close your eyes.

2. Identification of declaratives.
Here are three pictures (no. 20) and you point to the picture that describes the sentence:
A man is reading a book.
Picture of a man.
Picture of a book.

3. Identification of interrogatives.
Here are some pictures (no. 21 & 22) and you point to the following:
Show me who struck the car?
Whom did the car strike?
Do cows fly?
Do babies sleep?

B. Tests for expression.

1. Expression of declaratives.
Here are some pictures (no. 23) and you describe these in sentences.

2. Expression of imperatives.
Here are two hand puppets and think (pointing to the man's puppet) that this is joe and this is a dog (pointing to the dog puppet). Now how would Joe tell the dog:
to lie down.
to look up.
to close his eyes.

3. Expression of interrogatives.
Here are two puppets and tell me how would Joe ask the dog:
Where the post office is.
What time it is.
If he is an animal.
If he can bark.

IV. Tests for contextual information.

A. Tests for comprehension.

1. Identification of given/new.
   Here are two pictures (no. 24) and show me which one describes this:
   It is the girl who is petting the dog.
   Now show me who is petting the cat?
   What is the boy petting?

2. Identification of topic.
   Here are four pictures (no. 25) and you point to the common topic to all these pictures.

B. Tests for expression.

1. Expression of given/new.
   Here are two pictures (no. 26) and you answer to the following:
   Who is petting the dog?
   What is the girl petting?

2. Expression of topic.
   Here are four pictures (no. 27) and you tell me the common topic to all these.

3. Expression of focus.
   Can you tell me a story for about one or two minutes?
   Or can you narrate any event?

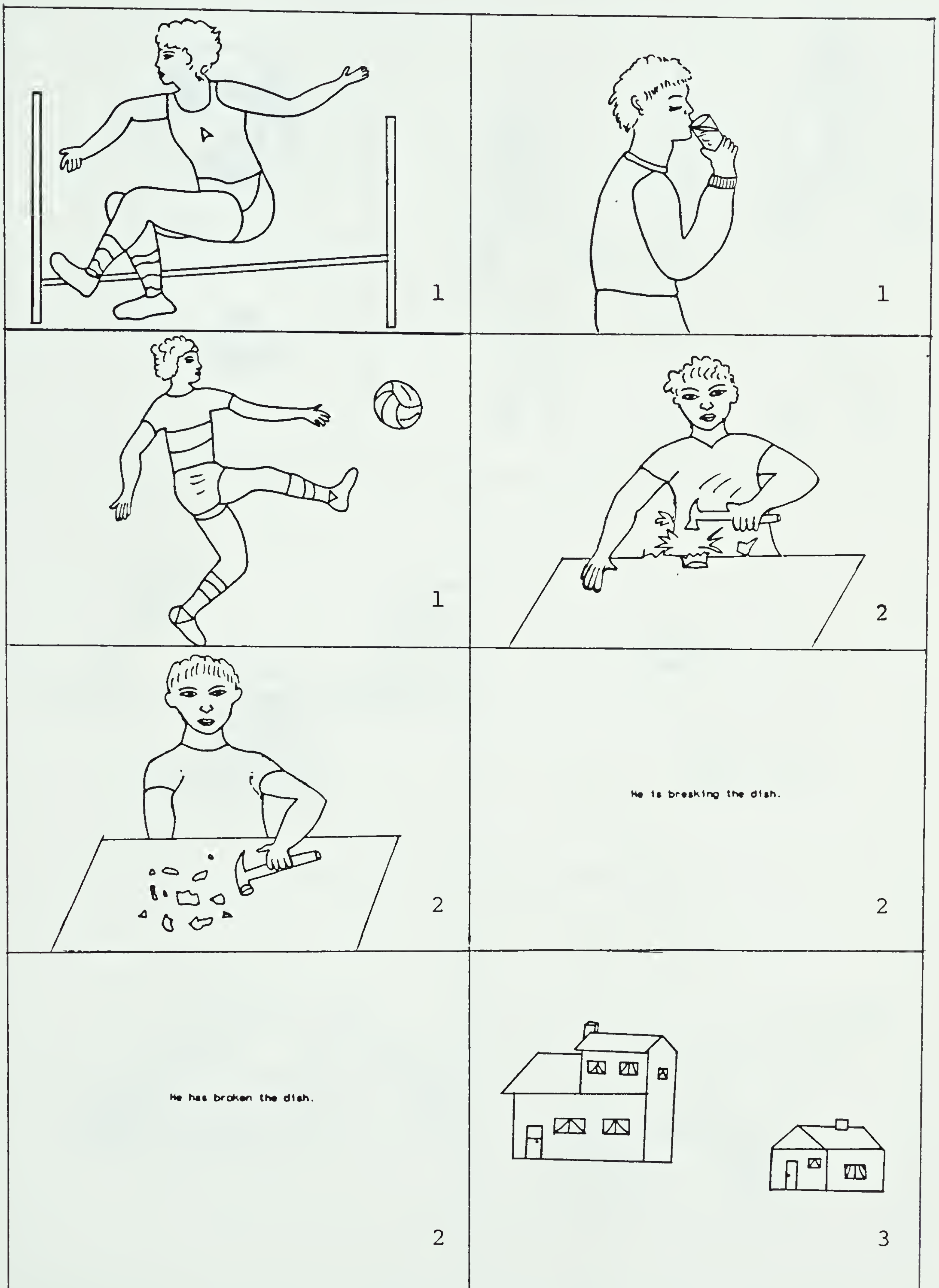
Control tasks.

1. Identification of logical sequence.
   Here are five pictures (no. 28) and I want you to arrange them in a logical sequence, i.e., which is first and which is second etc.?

2. Expression of logical sequence.
   Here are some pictures (no. 29) and can you arrange them in a logical sequence and describe each one?

3. Narration.
   Here is a picutre (no. 30) and can you tell me what is happening in this picture?

APPENDIX B: Pictures



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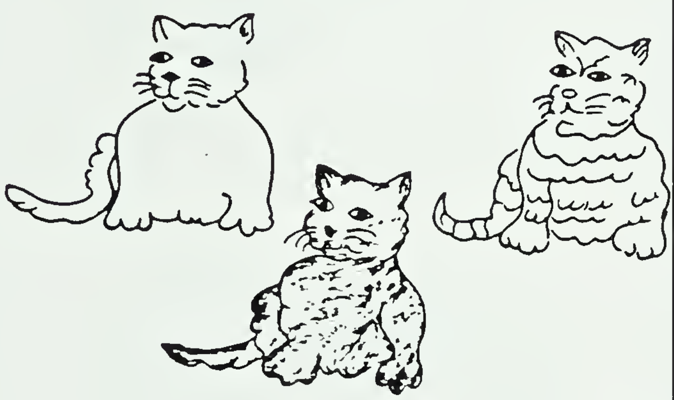

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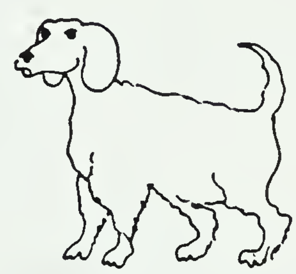

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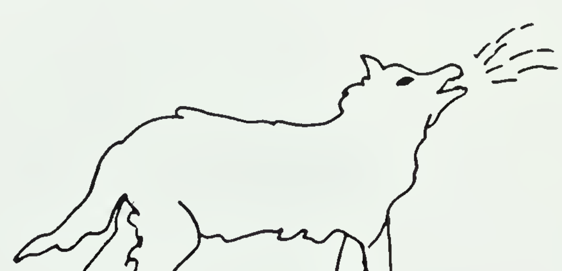

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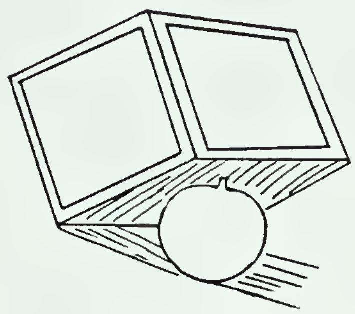

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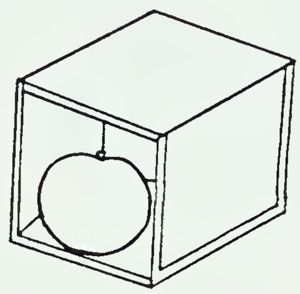

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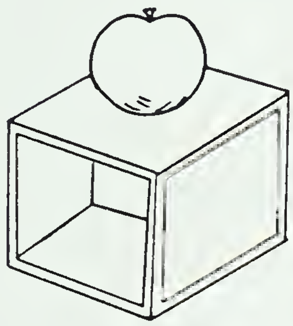

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The apple is under the box.

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The apple is on the box.

6

The apple is in the box.

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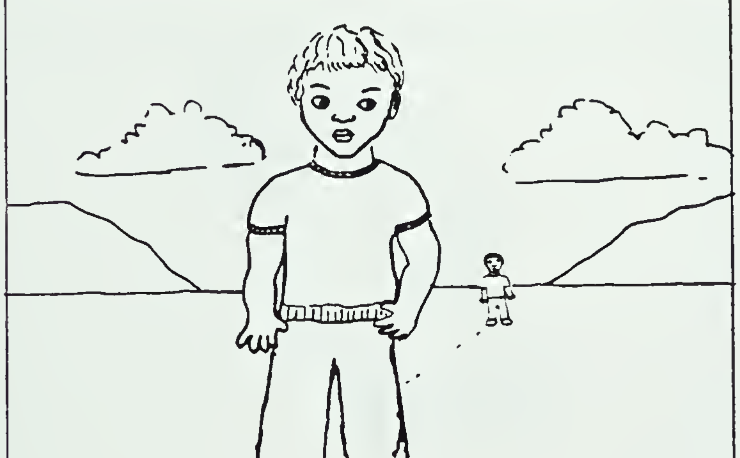

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The boy is here.

7

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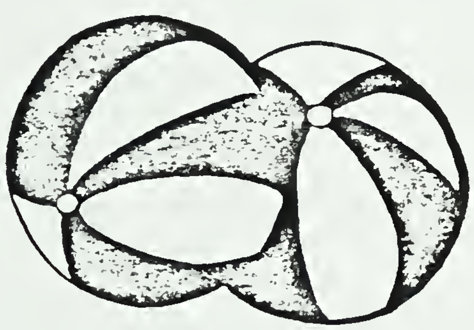
The boy is there.

7

The girl walks slowly.

7



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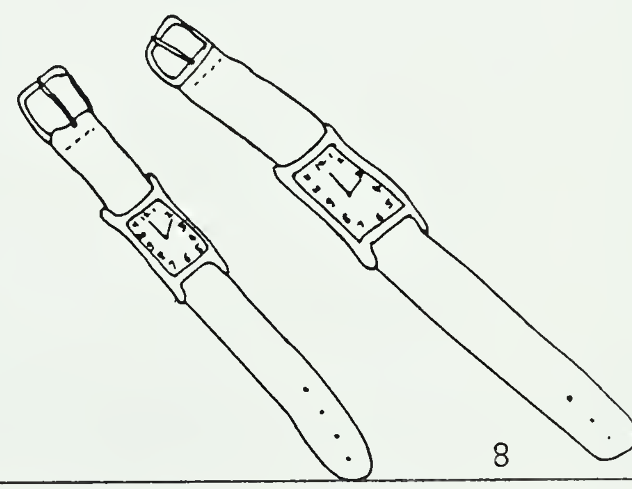

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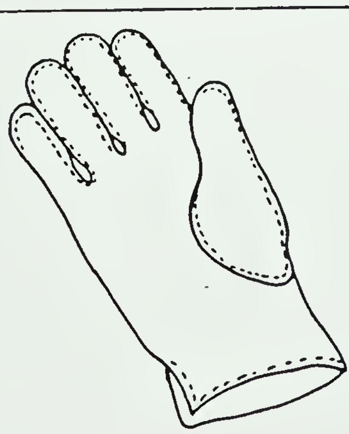

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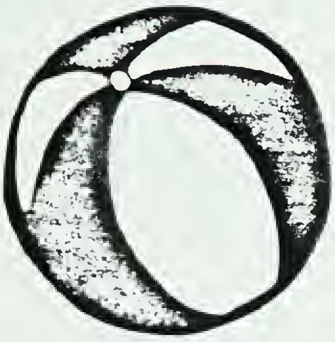

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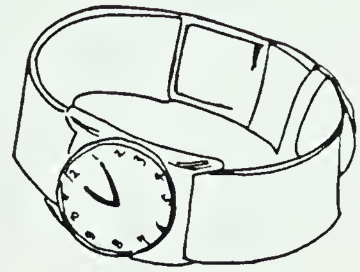

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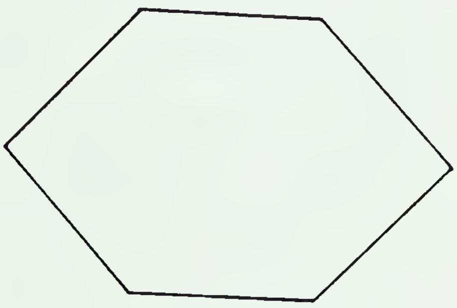

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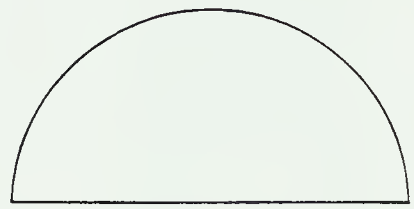

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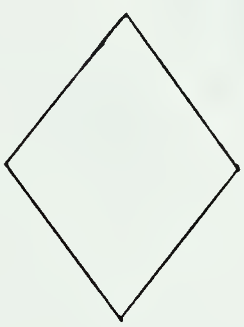

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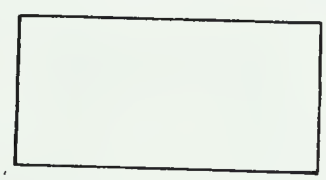

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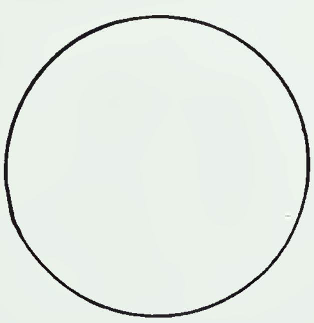

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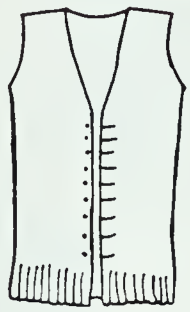

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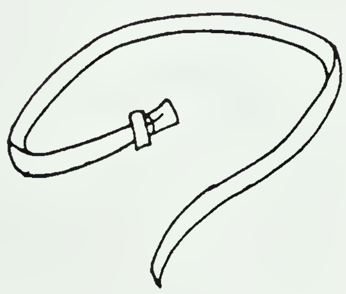

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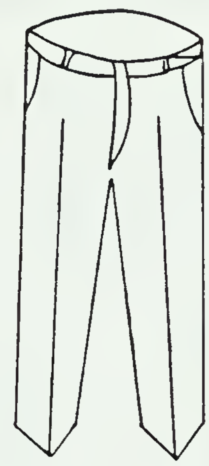

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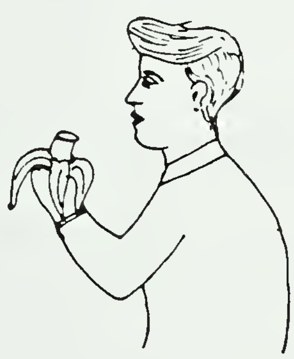

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He is not drinking water.

10

He is drinking water.

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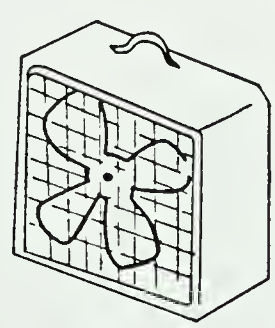

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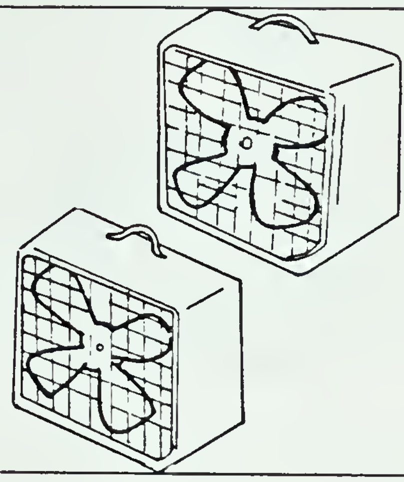

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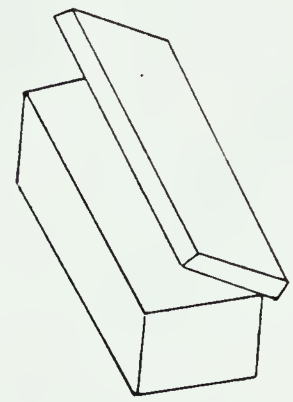

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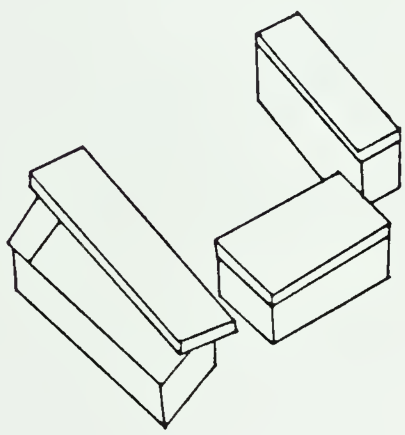

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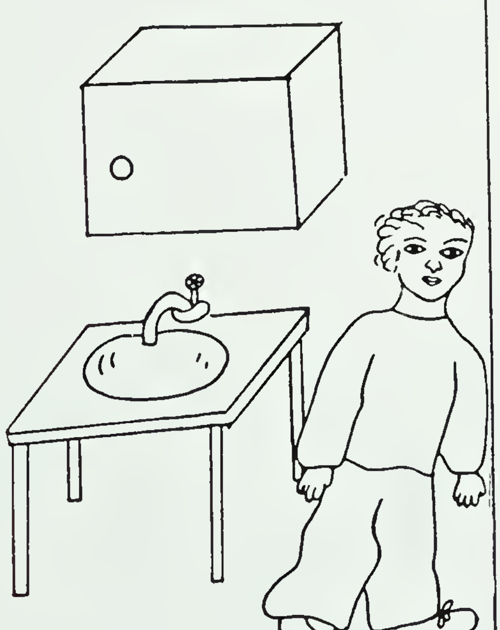

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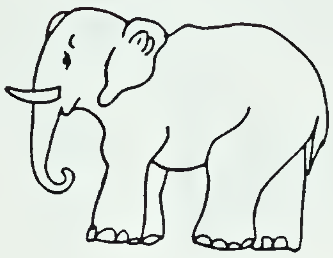

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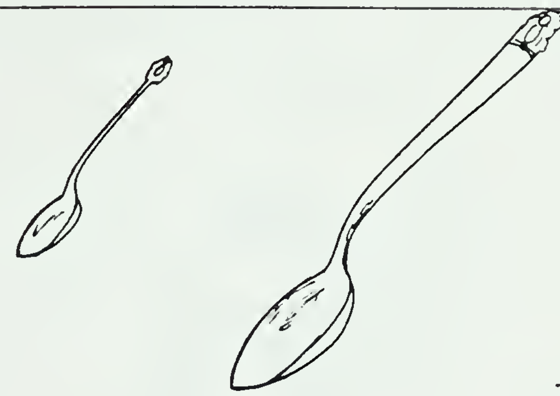

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He is a .... man.

13

This is a .... spoon.

13

An elephant is a .... animal.

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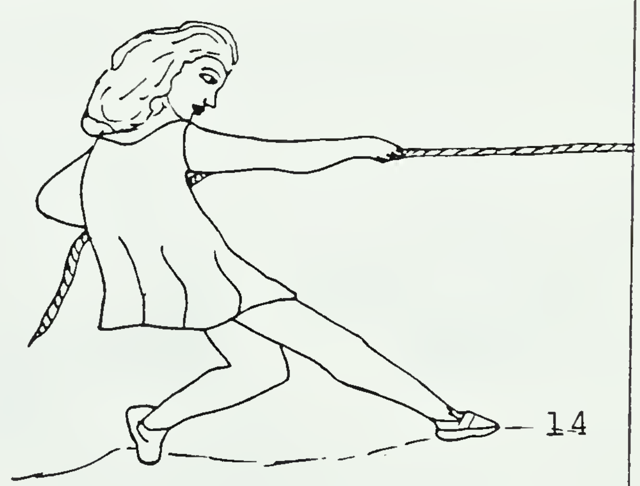

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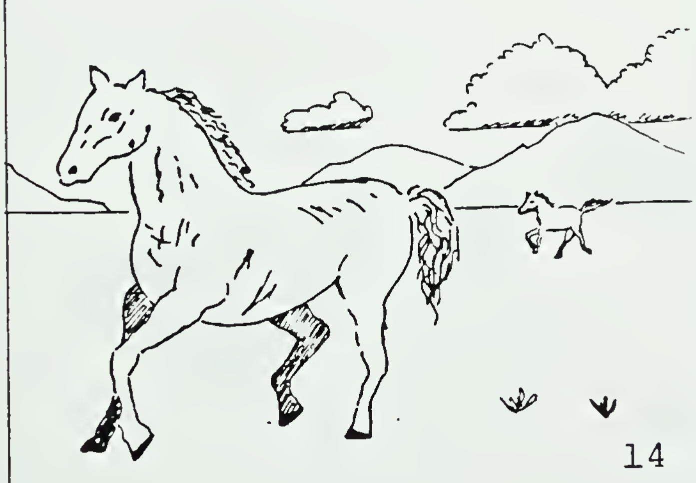

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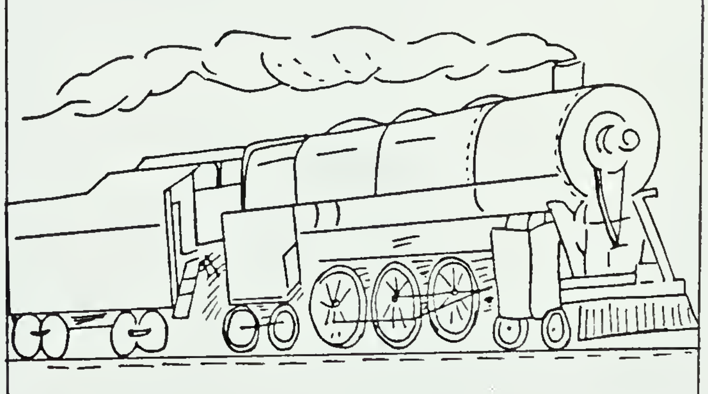

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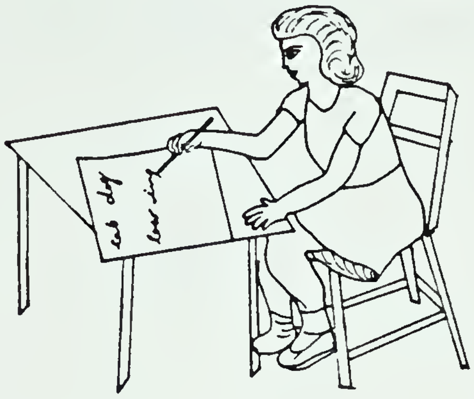

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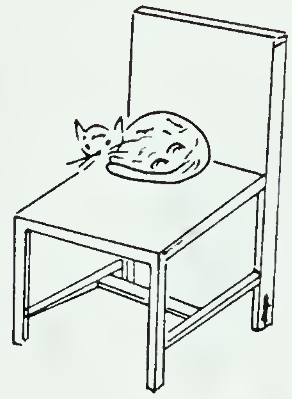

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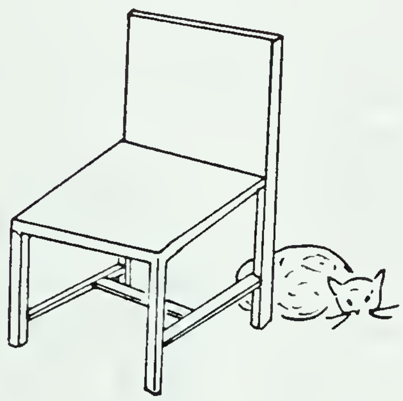

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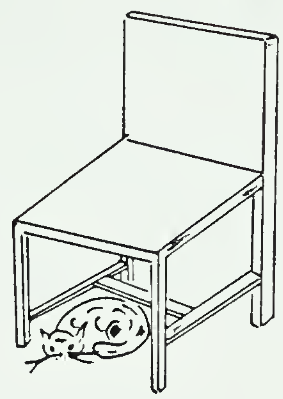

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The cat is ... chair.

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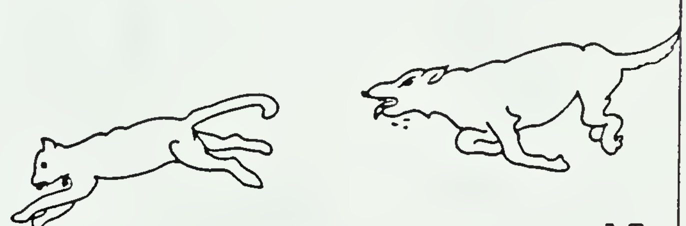

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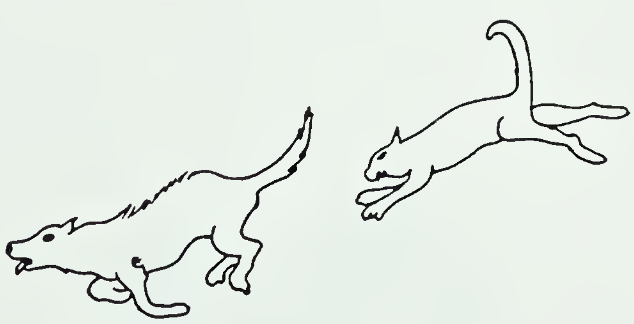

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A dog is chasing a cat.

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A cat is chasing a dog.

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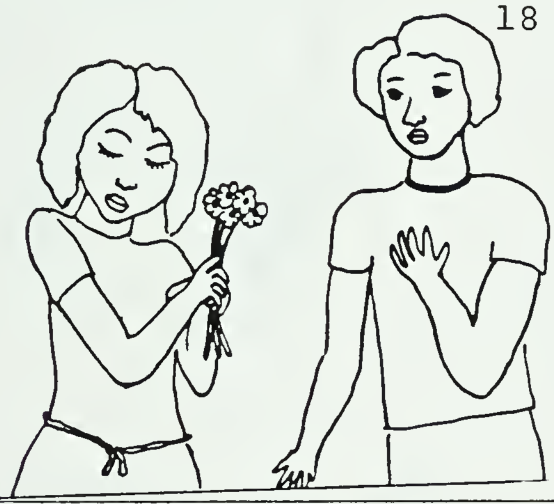

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John gave flowers to Mary.

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Mary was given flowers by John.

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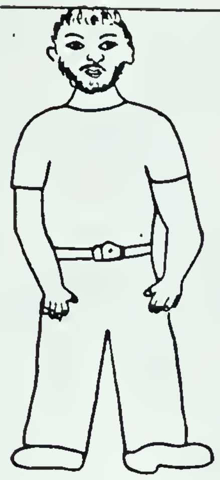

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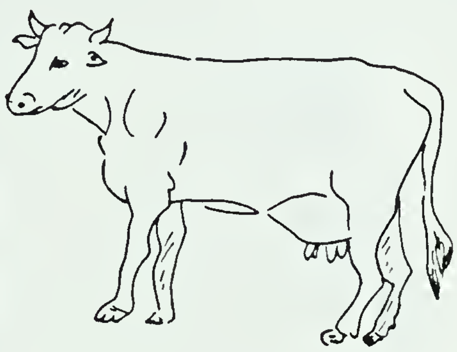

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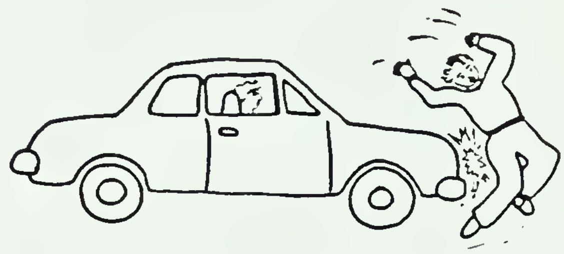

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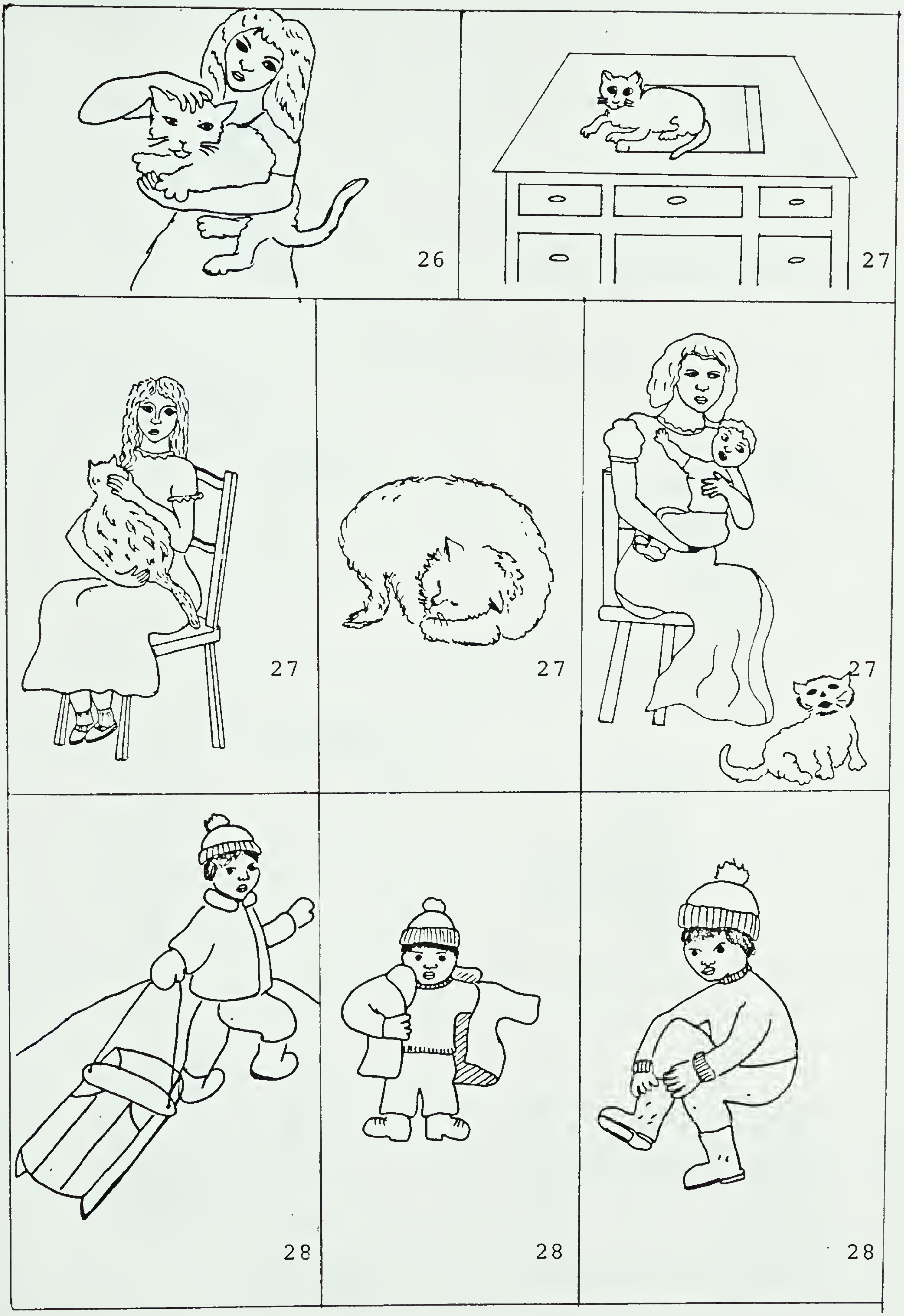
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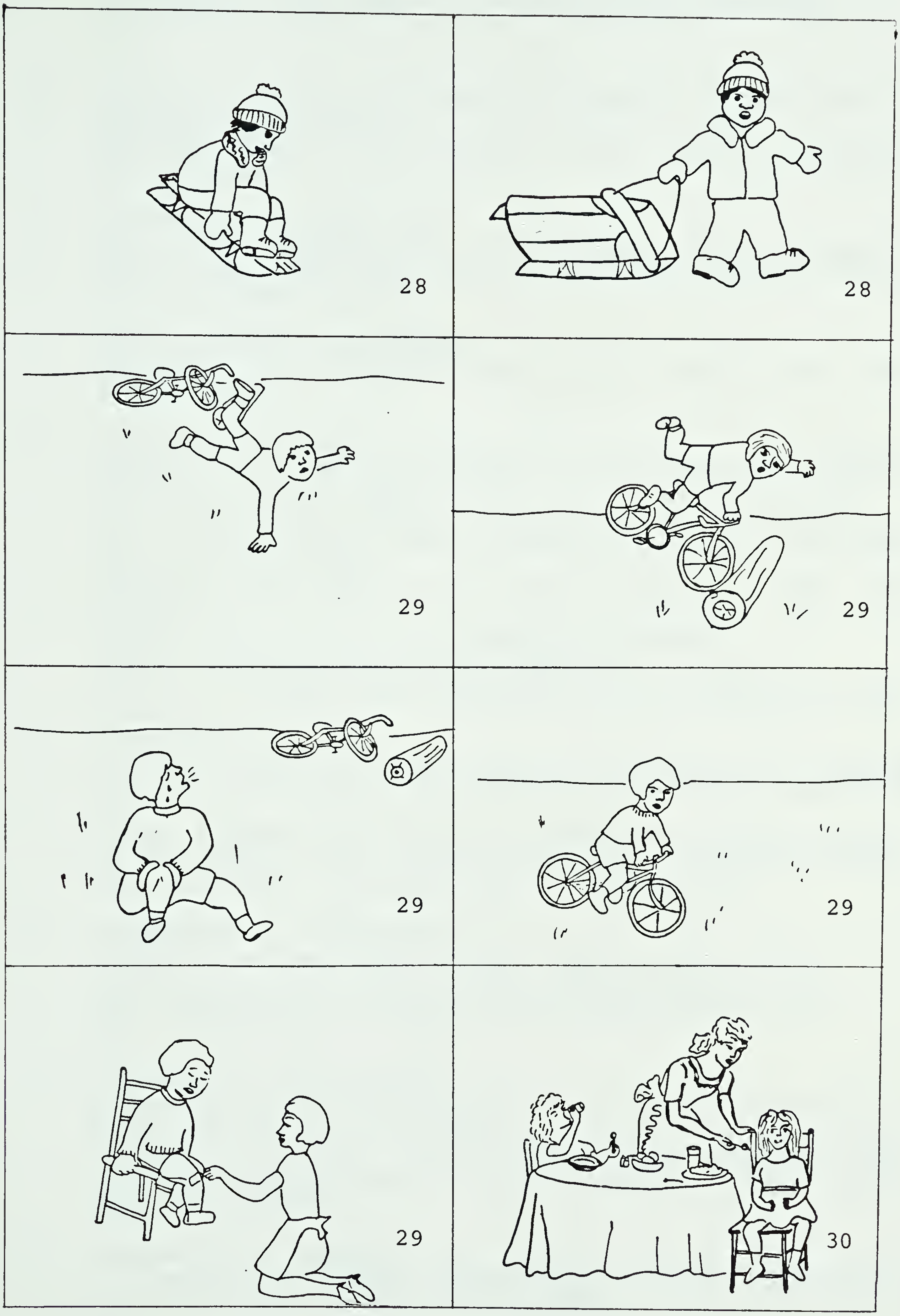
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APPENDIX C: The Range of Correct Verbal Responses

The range of responses are given for expression tasks only.

1. Expression of nouns:
   Key, pen, pencil, fork, spoon, coin, nickle, matches and matchbox.

2. Expression of bodyparts:
   Hair, ears, elbows, nose, eyes, mouth, teeth, fingers, knee, arm, leg, eye, chin, head, hand, stomach, neck, foot, shoulder & ankle.

3. Expression of noun number:
   One box; box; three boxes; boxes; one fan; fan; two fans; fans.

4. Expression of verb:
   Spoon - to eat your dinner; to eat with; for eating liquids; for stirring.
   Pen - to write a letter; for book work; for writing.
   Key - to unlock the door; to open the door; to open cars; to open locks
   Matches - to light with; to light a fire; to light the flame.
   Fork - to eat food; for salads; for eating.
   Pencil - to write with; for drawing.
   Nickle - for making a telephone call; to spend; to pay.

5. Expression of time:
   Doing - getting something out; looking into; opening the cabinet; looking on; opening up; putting something in.
   Done - closed; left; closed the cabinet; walking away; he has used; he has taken an aspirin; finished; washed; shut the door; found what he is looking for;

6. Expression of adjectives:
   Spoon - tea; baby spoon; small spoon; coffee spoon.
   Elephant - large; huge animal; big animal.
   man - huge man; big man; working man; business man.
   man - Short man; fat man.

7. Expression of categories:
   Colours - red; blue; green; black; yellow; purple; white; orange; pink; brown.
   Animals - horses; lamb; sheep; goat; elephant; dog; cat; cow; pig; tiger; lion; rabbit; turkey; swan; chicken; kangaroo.

8. Expression of adverbs:
   1 (Train) - on diesel; electricity; on the track; fast; very quickly; quickly; with a motor.

2 (Pull) - with her arms; tight; by leaning backwards; struggling; forcefully; with lot of muscle; hard; with difficulty; without falling down.
3 (Horse) - here; on the table; in front of me; in the mountains; in the meadow; below the train's picture; over there; in a field; in the middle.

9. Expression of negations:
No; no, she is writing; no she is not; no, she is drawing.

10. Expression of prepositions:
1. Underneath; under.
2. On top of; on.
3. besides; behind; back.

11. Expression of S/DO/IO:
John is giving Mary a book; John is presenting Mary a book; she is taking a book from him; John is giving the book to Mary; John is handing a book to Mary; Mary is giving the book to John; Mary is being given a book by John; John has borrowed a book from Mary and he is giving it back to her.

12. Expression of declaratives:
1. The boy is swimming; the guy is swimming; the girl is swimming.
2. The girl is sleeping; this person is sleeping.
3. The boy is washing; he is washing his face; this person is washing his face; he is wiping his face with a towel.

13. Expression of interrogatives:
1. Look up; look up Joe;
2. Lie down; lie down Joe.
3. Close your eyes; close your eyes dog.

14. Expression of interrogatives:
1. What time is it? could you tell me what time is it?
2. Are you an animal?
3. Where is the post office? could you tell me where the post office is?
4. Can you bark?

15. Expression of given/new:
The girl; the dog.
The boy; the cat.

16. Expression of topic:
The cat; cat.

17. Expression of logical sequences:
1. The boy is going for a ride; the boy is riding; the guy is riding; the guy is riding a bike; he is riding.

2. He hits a log; trips over the log; he hits a tree stem; he is hitting the log; hits a piece of wood; he bumps over;
3. falls off; falls off the bike.
4. He is hurt; his knee is hurt; hurts himself and cries; hurts his knee;
5. Mother puts a bandage; the mother is putting a patch.

18. Expression of narration:
Every body is eating food, it is dinner time, but this girl is not eating properly, so the mother is feeding her, this girl is eating well.

APPENDIX D: Questionnaire

NOTE: Find the hardest task and give it a 9 and the easiest and give it a 1 before going on to rank the remainder. Having found the end points rank the remaining ones.

Tests for denotational information.
Tests for comprehension:
1. Id of nouns
2. Id of body parts
3. Id of verbs
4. Id of time
5. Id of adjective
6. Id of adj+N
7. Id of N+Rel Clause
8. Id of prepositions
9. Id of adverbs
10. Id of number of nouns
11. Id of categories
12. Id of negations.

Tests for expression:
1. Ex of nouns
2. Ex of body parts
3. Ex of number of nouns
4. Ex of verbs
5. Ex of time
6. Ex of adjectives
7. Ex of categories
8. Ex of adverbs
9. Ex of negations
10. Ex of prepositions

Tests for relational information.
Tests for comprehension:
1. Id of Subject
2. Id of DO
3. Id of IO

Tests for expression:
1. Ex of Subject
2. Ex of DO
3. Ex of IO

Tests for sentential information.
Tests for comprehension:
1. Id of imperatives
2. Id of declaratives
3. Id of interrogatives

Tests for expression:
1. Ex of declaratives
2. Ex of imperatives
3. Ex of interrogatives

Tests for contextual information.
Tests for comprehension:
1. Id of given/new strategy
2. Id of topic
Tests for expression:
1. Ex of given/new strategy
2. Ex of topic
3. Ex of focus

APPENDIX E: Subject Information Sheet

Subject group: Date: Time taken:
1. Normals
2. Brain-damaged nonaphasics
3. Brain-damaged aphasics

Serial No:

Age:

Sex:

Mother tongue:

Educational attainment:

Type of brain damage (Medical diagnosis):

Onset of illness:

Others if any:

APPENDIX F: Score Sheet

0-No response
1-Incorrect response
2-Correct gestural response
3-Correct verbal response

Tests for denotational information

1. Id of nouns
   1
   2
   3
2. Id of body parts
   1
   2
   3
3. Id of verbs
   1
   2
   3
4. ID of time
   1
   2
5. Id of adjectives
   1
   2
   3
6. ID of adj+N
   1
7. Id of N+Rel Clause
   1
8. Id of prepositions
   1
   2
   3
9. Id of adverbs
   1
   2
   3
10. Id of number of nouns
    1
    2
    3
11. Id of categories
    1
    2
12. Id of negations
    1

Total (Max. Score=84)

Tests for expression

1. Ex of nouns
   1

2
3
2. Ex of number of nouns
1
2
3
3. Ex of body parts
1
2
3
4. Ex of verbs
1
2
3
5. Ex of time
1
2
6. Ex of adjectives
1
2
3
7. Ex of categories
1
2
8. Ex of adverbs
1
2
3
9. Ex of negations
1
10. EX of prepositions
1
2
3
Total (Max. Score=78)

Tests for relational information
Tests for comprehension
1. Id of S/DO/IO
1
2
3
Total (Max. Score=9)
Tests for expression
Ex of S/DO/IO
1
2
3
Total (Max. Score=9)

Tests for sentential information
Tests for comprehension
1. Id of imperatives
1

2
3

2. Id of declaratives

1
2
3

3. Id of interrogatives
Yes/No

1
2

WH

1
2

Total (Max. Score=30)

Tests for expression
1. Ex of declaratives

1
2
3

2. Ex of imperatives

1
2
3

3. Ex of interrogatives
Yes/No

1
2

WH

1
2

Total (Max. Score=30)

Tests for contextual information
Tests for comprehension
Given/New 1
Topic 2
Total (Max. Score=6)

Tests for expression
Given/New 1
Topic 2
Focus 3
Total (Max. Score=9)

Control tasks:
1. Id of logical sequence: (Max. Score=3)
2. Ex of logical sequence: (Max. Score=3)
3. Narration: (Max. Score=3)

APPENDIX G: Raw Scores for the BDA Group

Subject No.	DIC	SIC	RIC	CIC	CON1	DIE	SIE	RIE	CIE	CON2	CON3
1	84	30	9	6	3	77	27	9	7	3	3
2	84	29	9	6	3	65	19	9	9	3	3
3	84	30	9	6	3	72	25	9	9	3	3
4	83	30	9	6	3	68	30	9	9	3	3
5	82	30	9	6	3	76	16	9	7	1	3
6	83	30	9	2	3	76	16	9	8	3	3
7	82	30	9	4	3	72	24	9	8	3	3
8	84	30	3	6	3	76	16	7	7	3	3
9	82	28	9	6	3	65	24	8	7	2	2
10	84	30	5	5	3	62	16	9	7	1	1
11	73	29	9	2	3	68	11	7	7	1	1
12	77	30	9	4	1	39	8	7	6	1	1
13	71	22	3	5	3	47	4	2	6	0	0
14	69	28	9	6	3	55	19	7	8	3	1
15	84	26	9	6	1	67	14	9	7	2	2
16	74	30	9	6	3	16	2	0	0	1	0
17	78	26	9	6	1	4	0	0	0	0	0
18	45	18	3	3	0	42	8	3	2	0	1
19	62	12	9	0	0	48	3	5	1	0	0
20	78	21	8	2	1	0	0	0	0	0	0
21	45	22	3	1	0	30	1	0	1	0	0

22	66	18	3	1	0	30	1	0	1	0	0
23	65	10	6	0	0	31	0	0	0	0	0
24	46	11	0	3	0	28	11	0	3	0	0
25	66	20	3	2	0	0	0	0	0	0	0
26	66	28	9	3	3	32	2	0	2	1	0
27	48	7	0	0	0	2	0	0	0	0	0
28	16	2	0	0	0	5	0	0	0	0	0
29	27	6	0	0	0	2	0	0	0	0	0
30	5	0	0	0	0	4	0	0	0	0	0